Guideline Adherence for Hypertension and Type 2 Diabetes Mellitus

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Abstract

Background: Hypertension and Type 2 Diabetes Mellitus (T2DM) are highly prevalent worldwide and in Belgium, with significant challenges being posed by these pathologies for healthcare systems, due to their role in cardiovascular morbidity and mortality. Despite the availability of evidence-based guidelines, published by the European Society of Cardiology (ESC) and the European Association for the Study of Diabetes (EASD), real-world adherence to them remains variable.
Objective: This study investigates to what extent six general practitioners across two primary care practices in Belgium adhere to these guidelines.
Methods: Using a cross-sectional, observational study design, we analyzed patient data in a retrospective manner and conducted structured interviews with GPs to assess patterns in screening, diagnosis, risk stratification, pharmacological management, and follow-up.
Results: The results highlight gaps in adherence, including infrequent HbA1c monitoring in T2DM, underuse of nephro- and cardioprotective agents in both conditions, and minimal use of urine albumin-creatinine ratio (UACR) testing. Hypertension management showed higher adherence levels than T2DM with minimal therapeutic inertia. GP interviews revealed that barriers to adherence include reimbursement limitations, reliance on experiential knowledge, patient resistance, and practical constraints such as time and documentation burden.
Conclusions: This study underscores the need for improved integration of guidelines into daily practice through simplified protocols, structured follow-up, interdisciplinary collaboration, and targeted education. Enhancing adherence can improve disease outcomes and align primary care practices with current clinical standards.

Introduction

Hypertension and type 2 diabetes mellitus (T2DM) are two of the most prevalent conditions globally and in Belgium (1 in 4 people in Belgium have hypertension **[1]** and 1 in 10 have T2DM **[2]**). Both pathologies pose significant challenges for public health, underscoring the importance of efficient disease management to reduce their contribution to cardiovascular and all-cause morbidity and mortality in the world **[3-5]**.

Management of these conditions includes lifestyle interventions and pharmacological regimens, as well as timely screening for organ damage, risk factors, comorbidities and complications. The European Association for the Study of Diabetes (EASD) **[6]** and the European Society of Cardiology/European Society of Hypertension (ESC-ESH) **[7]** have published guidelines for these pathologies with evidence-based recommendations for clinicians.

General Practitioners (GPs) play an important role in screening and treatment of hypertension and T2DM because they are often the first point of contact for patients with these conditions. While the EASD **[6]** and ESC/ESH **[7]** guidelines are well established, adherence to them in practice can vary due to several factors, such as clinical judgment, physician and patient preferences and time constraints that may influence the decision-making process. Inconsistency in prescribing behavior may have implications on the quality of patient care and health outcomes, thus asserting the need for studies assessing guideline adherence. While some studies have explored this issue **[8-10]**, few have investigated prescribing behavior within individual GP practices. This leaves a gap in understanding how GPs' adherence to guidelines varies in local clinical settings and what factors may contribute to this variation. In this study, our objective is to assess the instances in which GPs in two practices in Belgium tend to deviate from or adhere to established guidelines. Additionally, we will investigate the motivational factors influencing (non-)adherence to guidelines.

Literature Study

Summary of the guidelines for Type 2 Diabetes Mellitus

The most recent update of the European Association for the Study of Diabetes (EASD) guidelines for the management of T2DM was published in 2022 as a joint consensus report with the American Diabetes Association (ADA) **[6].** The report emphasises a person-centred and holistic approach to diabetes care,which is individualised based on each patient's preferences, comorbidities, complication risks and social circumstances while being structured around principles of shared decision-making and patient empowerment. In what follows, a summary of the guidelines is depicted.

Screening and Diagnosis

In routine practice, asymptomatic patients aged over 40 years, should receive screening for diabetes by blood sample every three years, with screening in high risk individuals starting earlier and/or more frequently (eg obesitas, PCOS, antecedents…). Symptomatic patients (with polyuria, polydipsia and unintentional weight loss) should also be screened, independent of age. Although not mentioned in the EASD guidelines, high risk individuals can be identified by using risk scores, such as FINDRISC (FINnish Diabetes RIsk SCore) **[11]**, predicting the 10 year risk of an individual for developing diabetes with 85% accuracy.

The rationale for active screening for T2DM in a healthy population lies in the fact that organ damage can occur early on, with glycemic control by early treatment meant to prevent complications and disease progression. Diagnostic tests for diabetes include Fasting Plasma Glucose (FPG), Hemoglobin A1c (HbA1c) and Oral Glucose Tolerance Test (OGTT). FPG remains the first choice test, but in individuals unable to fast or in whom FPG is distorted because of (acute) illness, HbA1c can be a valuable measure. HbA1c can however be unreliable in patients with hemoglobinopathies, anemia, or an estimated glomerular filtration rate (eGFR) <60 ml/min/1,73m². The OGTT with 75g glucose is particularly sensitive in early T2DM detection and is recommended in cases where doubt persists (e.g., high risk individuals with normal FPG and HbA1c). Continuous Glucose Monitoring (CGM) is mostly used for glycemic monitoring, rather than for diagnostic purposes. *See figure 1 for diagnostic thresholds.*

	FPG	HbA1c	OGTT	Non-fasting PG
Diabetes	2x ≥126mg/dL	≥6,5%	2h ≥200mg/dL	≥200 mg/dL
Pre-diabetes	≥110mg/dL	≥5,7%	2h ≥140mg/dL	/

Figure 1: Diagnostic thresholds for T2DM

Initial assessment

Upon diagnosis, all patients should receive a risk stratification, assessing for comorbidities and risk factors to determine optimal treatment regimens and if needed, personalise treatment targets. The initial work-up should include:

- Assessment of lifestyle factors (dietary habits and physical activity)
- Measurement of body weight, BMI and blood pressure
- Lipid profile for evaluation of cardiovascular risk (CVR)
- Renal function tests and urine albumin-to-creatinine ratio (UACR)
- Fundoscopy to screen for diabetic retinopathy
- Foot examination (e.g., neurofilament testing) to detect peripheral neuropathy

Management

Treatment strategy

The primary goal of diabetes management is lowering glycemia, because glycemic control is important for preventing complications and slowing disease progression. Timely interventions are thus essential and should not be delayed. For efficient disease management, cooperation by a multidisciplinary (para-)medical team is recommended involving GPs, endocrinologists, diabetes educators, dietitians, pharmacists, and other specialists (e.g., dentists, ophthalmologists, podiatrists, psychologists and neurologists). Each treatment and follow-up regimen should be personalised to the patients unique profile and evolving needs. Lifestyle modifications are a key part of the management of diabetes, alongside medication.

Central in diabetes management is education, provided through Diabetes Self-Management Education and Support (DSMES) programs, a concept designed to improve lifestyle, medication adherence, self-monitoring, disease coping and problem-solving skills. These concepts should be organised in structured programs including ongoing guidance. Correct implementation of DSMES has demonstrated benefits in glycemic control, disease insight, clinical and psychological outcomes, hospital admission rates, and mortality in a cost-effective manner.

Diabetes Care in Belgium

In Belgium, diabetes care is structured into three gouvernment-funded systems: *Opstarttraject* (start-up trajectory), *Zorgtraject* (care trajectory), and *Conventie* (convention), based on the treatments received by patients **[12]** *(figure 2).* These systems are based on the same pillars as recommended by the EASD guidelines: education, lifestyle modification, pharmacotherapy, and (para-)medical follow-up. These structures entitle every diagnosed individual to appropriate care and financial compensation, streamlining follow-up and treatment adherence *(figure 3).*

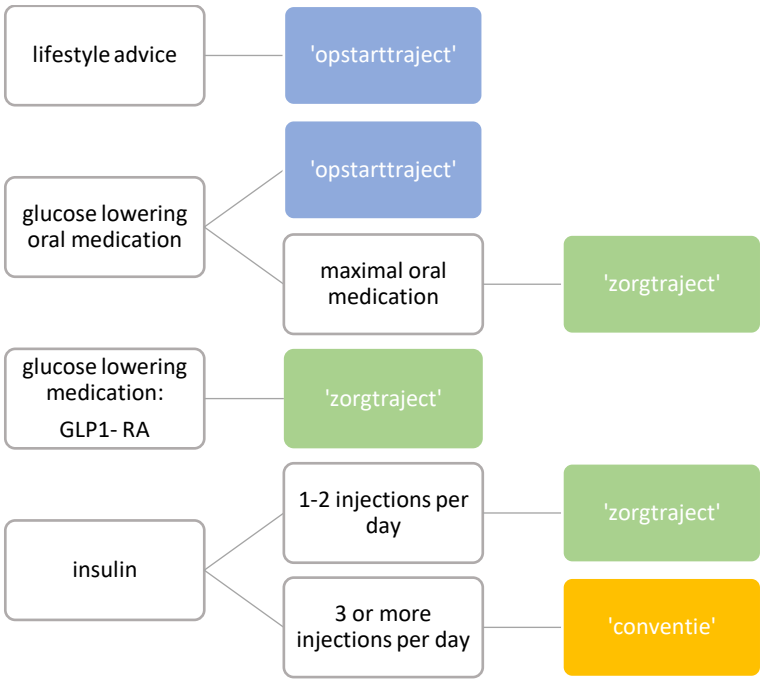


Figure 2: Gouvernment-funded Type 2 Diabetes Mellitus care systems in Belgium

	'OPSTARTTRAJECT'	'ZORGTRAJECT'	'CONVENTIE'
Application	GP coordinates w/o contract	GP w/ contract	Hospital/specialist w/ approval of health insurance
Endocrinologist	No	Yes	Obligated 1x/y
Education	4x30 min/y	5x30 min/y	In specialist team
Dietitian	2x30 min/y	2x30 min/y	In specialist team
Podiatrist	2x45 min/y	2x45 min/y	2x45 min/y
Dentist	1x/y	1x/y	1x/y
Self control	None	1 blood glucose meter/3y 150 strips/6m 100 lancets/6m	1 blood glucose meter/3y 130 strips/m 100 lancets/6m

Figure 3: Elements included in the different Belgian diabetes care systems

In addition to these care systems, other initiatives have been introduced by the Belgian government, such as *Bewegen op Verwijzing* (Movement by Referral) **[13]**; a project that provides coach-led physical activity at subsidised rated. Smoking cessation programs **[14-15]** are similarly supported, with low-cost individual or group sessions with trained paramedics.

Lifestyle Interventions

All patients with T2DM should adopt a healthy lifestyle, comprising a balanced diet, regular physical activity, smoking cessation, and weight management. These interventions are particularly important in the early stages of diabetes (e.g., prediabetes), where the disease may still be reversible. A weight reduction of 5-15% should be a primary target in patients with overweight or obesity, with reductions exceeding 10% potentially leading to remission of diabetes (=normal glycemia during 3 months follow-up without pharmacological glycemia lowering agents) **[16]**. Intensive lifestyle interventions have shown to better diabetes control and better quality of life with reduced health care use and costs **[17]**. In *figure 4* the different lifestyle interventions for T2DM are shown.

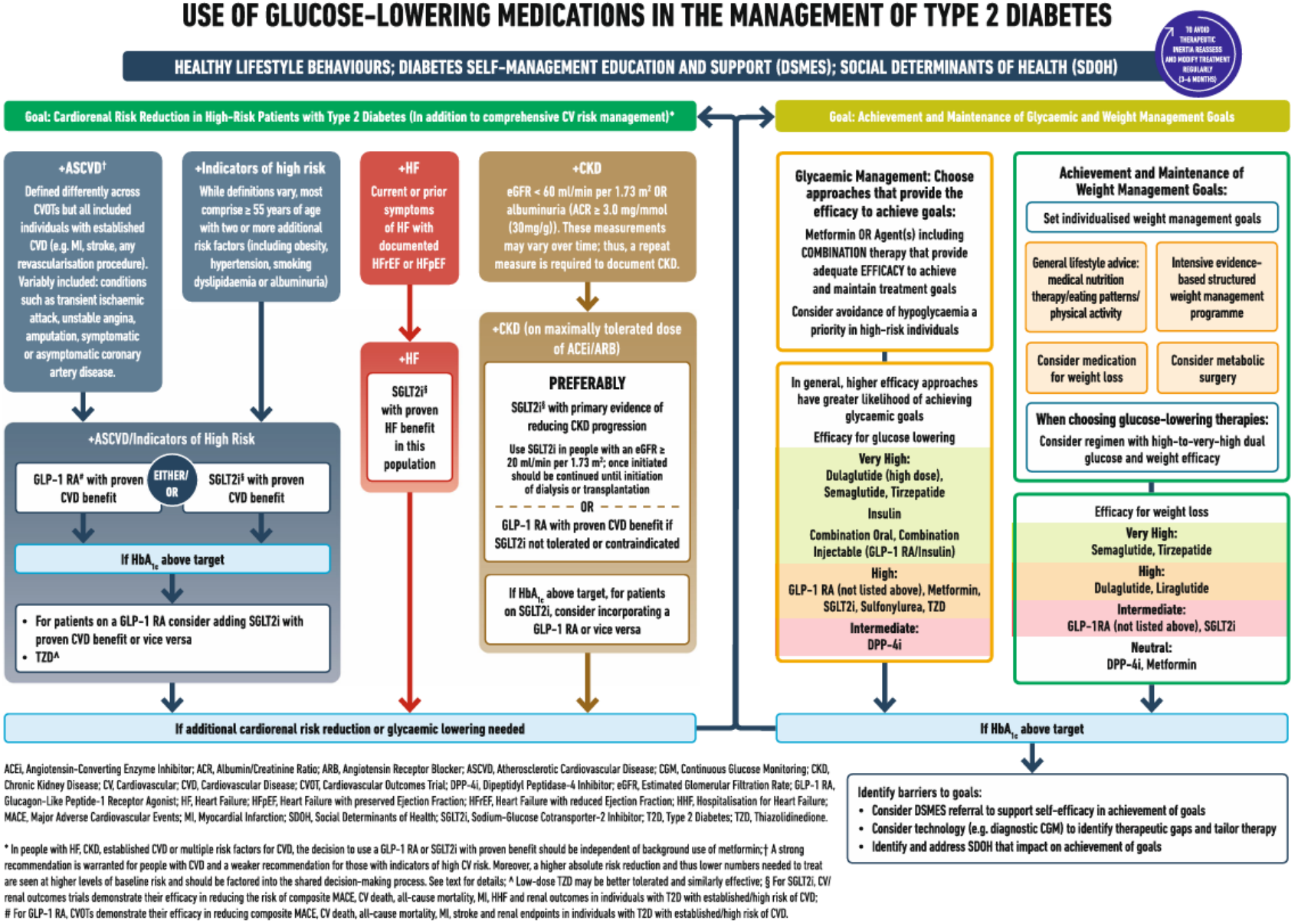
Medical Nutritional Therapy (MNT)	Physical activity	Weight loss	Sleep
- Individualised - Dietitian - Mediterranean diet - Low in carbs - Calory restriction	- Aerobic 150min/w - Resistance 2-3x/w - Equilibrium (elderly) - Step count - No prolonged sitting	- Lifestyle - GIP and GLP1-RA - Surgery if BMI ≥40kg/m²	6-8 hours per night
Lower HbA1C Postpone complications	Lower HbA1c Better glycemic control Postpone physical deterioration	Could induce remission! Better metabolic profile	Better insulin sensitivity Less energy uptake

Figure 4: Lifestyle interventions in Type 2 Diabetes Mellitus management and their usefulness

Pharmacological Treatment

Pharmacologic treatment should complement lifestyle modification and DSMES. The choice of medication agent should be guided by the individual patient profile, especially the presence of comorbidities, risk of side effects and preferences. See *figure 5* for a decision-making chart on pharmacotherapy.

Unless contraindicated, metformin is recommended as the first-line agent in the treatment of T2DM, due to its proven efficacy, safety, affordability, and cardiovascular benefits. For patients with established cardiovascular disease or high CVR, glucagon-like peptide-1 receptor agonists (GLP1-RA) or sodium-glucose transport protein inhibitors (SGLT2i) are recommended, either as initial therapy or as add-on to metformin, regardless of glycemic control. In individuals with heart failure or chronic kidney disease (CKD) **[18]**, SGLT2i are preferred, while in high stroke risk GLP1-RA are preferred because of their benefit in preventing major cardiovascular events (MACE) **[19]**. When there is a need to reduce the cost of treatment, the guidelines prescribe to work with sufonylureas (SU) or thiazolidinediones (TZD). Insulin therapy is reserved for patients who do not achieve glycemic targets despite maximal oral therapy and/or GLP1-RA. Initial insulin regimens should start with basal insulin, whith prandial insulin added only if necessary. If HbA1c is <6,5%, medication with high hypoglycemic risk should be stopped, especially in older frail patients. If HbA1c is above target, combination therapy should be initiated. Immediate combination therapy is warranted in patients with HbA1c ≥8,5%, younger patients, or when cardiorenal protection prioritised. In *figure 6* and *figure 7* the properties and side-effects of the different glucose-lowering agents are listed.



ACEi, Angiotensin-Converting Enzyme Inhibitor; ACR, Albumin/Creatinine Ratio; ARB, Angiotensin Receptor Blocker; ASCVD, Atherosclerotic Cardiovascular Disease; CGM, Continuous Glucose Monitoring; CKD, Chronic Kidney Disease; CV, Cardiovascular; CVD, Cardiovascular Disease; CVOT, Cardiovascular Outcomes Trial; DPP-4i, Dipeptidyl Peptidase-4 Inhibitor; eGFR, Estimated Glomerular Filtration Rate; GLP-1 RA, Glucagon-Like Peptide-1 Receptor Agonist; HF, Heart Failure; HFpEF, Heart Failure with preserved Ejection Fraction; HFrEF, Heart Failure with reduced Ejection Fraction; HHF, Hospitalisation for Heart Failure; MACE, Major Adverse Cardiovascular Events; MI, Myocardial Infarction; SDOH, Social Determinants of Health; SGLT2i, Sodium-Glucose Cotransporter-2 Inhibitor; T2D, Type 2 Diabetes; TZD, Thiazolidinedione.

* In people with HF, CKD, established CVD or multiple risk factors for CVD, the decision to use a GLP-1 RA or SGLT2i with proven benefit should be independent of background use of metformin; † A strong recommendation is warranted for people with CVD and a weaker recommendation for those with indicators of high CV risk. Moreover, a higher absolute risk reduction and thus lower numbers needed to treat are seen at higher levels of baseline risk and should be factored into the shared decision-making process. See text for details; ^ Low-dose TZD may be better tolerated and similarly effective; § For SGLT2i, CV/renal outcomes trials demonstrate their efficacy in reducing the risk of composite MACE, CV death, all-cause mortality, MI, HHF and renal outcomes in individuals with T2D with established/high risk of CVD; # For GLP-1 RA, CVOTs demonstrate their efficacy in reducing composite MACE, CV death, all-cause mortality, MI, stroke and renal endpoints in individuals with T2D with established/high risk of CVD.

Figure 5: Decision-making in diabetes pharmacotherapy, extracted from EASD guidelines [6]

	Glucose lowering	Hypoglycemia risk	Body weight effect*	Price
Metformin	+++	-	0	Low
SGLT2i	++	-	+	High
GLP1-RA	++++	-	++	High
GIP+GLP1-RA	+++++	-	+++	High
DPP4i	+	-	0	High
TZD	+++	-	-	Low
SU	+++	+	-	Low
insulin	++++	+	-	High

Figure 6: Properties of glucose lowering medication

	Kidney function	Side effects
Metformin	CI if eGFR<30ml/min/1,73m²	Vit B12 deficit (neuropathy) Gastro-intestinal
SGLT2i	Glucose lowering effect diminishes with lower eGFR CI if eGFR<20ml/min/1,73m² CI if UACR<30mg/g	DKA risk → stop pre-operative, during sickness or fasting periods Urogenital candida Founier's gangreen Low BP
GLP1-RA	Monitor eGFR Renoprotective	Gastro-intestinal Pancreatitis Cholecystitis/-lithiasis Thyroid malignancy
GIP+GLP1-RA	Monitor eGFR Renoprotective	Gastro-intestinal Pancreatitis Cholecystitis/-lithiasis Thyroid malignancy
DPP4i	Neutral	Pancreatitis Arthralgy Bullous pemphigoid
TZD	Neutral	Heart failure, fluid retention Bone fractures Weight gain
SU	Neutral	Hypoglycemia Weight gain
Insulin	Lower doses with poor kidney function	Injection site reactions Hypoglycemia

Figure 7: Side effect profiles of glucose lowering medication

Monitoring and Follow-up

Ongoing monitoring is essential to evaluate treatment efficacy, detect side effects, reassess comorbidities, and ensure adherence to lifestyle and pharmacologic interventions. Treatment goals should be reviewed at each visit, with glycemic targets adjusted to the individual's age, comorbidities, and hypoglycemia risk. If needed, therapy should be stepped up. While the EASD emphasizes this concept in their report, there's no mention of what the recommended follow-up frequency is nor of the risks and complications clinicians should screen for in the follow-up of T2DM patients. The National

Institute for Health and Clinical Excellence (NICE) guidelines **[20]** however, do provide recommendations for these aspects of care.

As a primary target, HbA1c should be measured in intervals ranging from every three months to every six months, with a general target of <7%. Looser or tighter targets may be appropriate depending on the individual's age, hypoglycemia risk and comorbidities. Routine measurement of HbA1c is important to keep track of diabetes control and to allow timely therapy adjustments. Frequency of measurements depend on how well the patient's glycemia is controlled: with time intervals up to six months being acceptable for well controlled patients, whilst poorly controlled patients should get measurements every 2-4 months **[20]**. Blood glucose monitoring (BGM) and CGM are particularly useful for patients on insulin regimens to optimize glycemic control. However, BGM and CGM are considered as an added cost and burden in other cases, with limited extra benefit. When glycemic targets are not met, treatment intensification should be considered, and adherence to therapy should be reviewed. Referral to DSMES programs is encouraged when adherence is uncertain.

On top of assessments of glycemic control, patients with T2DM should undergo regular screening for organ damage and complications *(figure 8),* including blood pressure measurements, blood lipid profile determination (and treatment when aberrant) **[21]**, kidney function and albuminuria checks, eye examinations, dental examinations **[22]** and foot examinations (pulses and monofilament test) **[23]**. Antiplatelet therapy should be considered for secondary prevention in individuals with high CVR or a history of cardiovascular disease. Treatment plans should be adjusted according to efficacy, tolerability, and patient preferences, with efforts to avoid therapeutic inertia.

	Frequency	Target
Glycemia	Every 2-6 months	HbA1c<7%
Blood pressure	Every visit + home measurements	<130/80mmHg
LDL-measurement	Every 3-12 months	VHR <55mg/dL HR <70mg/dL MR <100mg/dL
Kidney function	Annually	UACR <30mg/g and eGFR ≥60ml/min/1,73m²
Retinopathy	Annually	Ophtalmology visit
Neuropathy	Annually	Neurofilament testing

Figure 8; Steps in the follow-up of patients with T2DM

VHR = very high risk (the presence of ASCVD, target organ damage or at least 3 CV risk factors)

HR = high risk (diabetes ≥10 years without target organ damage

MR = moderate risk (diabetes <10 years without cardiovascular risk factors)

Summary of the guidelines for Hypertension

The European Society of Cardiology (ESC) and the European Society of Hypertension (ESH) updated their guidelines in 2024 **[24]**. However, the present study is based on the 2018 guidelines **[7]**. This choice was made because the data analyzed were collected in 2024, prior to the implementation of the 2024 guideline updates. For the sake of completeness, changes introduced in the 2024 update are addressed in the discussion section of this paper.

Screening and Diagnosis

The ESC/ESH guidelines recommend routine hypertension screening in general practice through regular in-office blood pressure (BP) measurements in all adults. The frequency of screening is stratified according to prior BP values:

- Every 5 years if BP <120/80 mmHg
- Every 3 years if BP is 120–129/80–84 mmHg

- Annually if BP is 130–139/85–89 mmHg

The latter category warrants suspicion of masked hypertension, which should be confirmed by ambulatory or at-home BP monitoring. Individuals with a history of cardiovascular disease (CVD), those at high CVR (based on the SCORE system) **[25]**, or those with white coat hypertension should undergo annual BP assessments regardless of previous measurements. The correct measuring technique for BP is with the patient seated for at least five minutes, using a correctly sized upper-arm cuff and two readings should be taken 1–2 minutes apart, in both arms. Orthostatic BP should be additionally evaluated in elderly patients and individuals with diabetes, measured at 1 and 3 minutes after standing. In-office measurements should be complemented by at-home measurements, ideally performed twice daily over at least three consecutive days, following the same protocol as in-office readings. Home measurements are a good tool to diagnose white coat and masked hypertension. In cases of white coat hypertension, annual follow-up and cardiovascular risk assessment are advised, given the increased CVD risk compared to normotensive individuals. Patients with masked hypertension should be treated such as hypertensive patients, because they have a comparable cardiovascular risk elevation.

Hypertension is defined by the ESC/ESH guidelines as blood pressure ≥140/90 mmHg in two separate in-office measurements (or a single measurement of grade 3 hypertension) or as at home BP measurements of ≥135/85mmHg. These thresholds represent the point at which therapeutic benefits outweigh potential treatment-related risks. In individuals with high CVD risk, lower diagnostic thresholds (≥130/80mmHg) are recommended. 24-hour ambulatory BP assessment is the gold standard for diagnosis, with thresholds set at a mean BP≥130/80mmHg. Grading of hypertension is done as shown in *figure 10*.

Initial assessment

Upon diagnosis, a comprehensive baseline assessment should be conducted to determine total CVD risk (SCORE) **[25]** and relevant comorbidities as well as the extent of hypertension-mediated organ damage (HMOD), if present. This is essential, as hypertension seldom occurs alone, and is often accompanied by other risk factors, which act synergistically to increase overall CVD risk. Initial investigations should include a blood sample, urine sample and a 12-lead ECG *(figure 9).*

Routine tests	
Blood sample	• Hemoglobin, Hct • Sodium, potassium, calcium • TSH • Creatinin and eGFR • Lipids: LDL, HDL, non-LDL, TG
Urine sample	UACR
12-lead ECG	LVH, AF, previous MI

Figure 9: Initial work-up of hypertensive patients

These assessments are especially important in patients with intermediate cardiovascular risk, where the detection of supplementary risk factors may lead to reaching a therapeutic threshold nevertheless. In individuals with high CVR or CVD, treatment initiation is warranted regardless of additional risk factors, as the therapeutic threshold will already be reached.

In some cases, supplementary screening for secondary causes of hypertension is recommended. This is the case in patients <40 years with hypertension, in resistant hypertension, in hypokalemia or with sudden worsening of hypertension. Evaluation for secondary hypertension should include plasma aldosterone-to-renin ratio, renal artery imaging (to detect stenosis) and 24-hour urinary catecholamines.

Management

Treatment strategy

For most adults, the target blood pressure is <140/90 mmHg, although lower targets may be pursued if well tolerated. A more cautious approach with less strict BP targets should be adopted in eldery patients who might not tolerate extensive antihypertensive regimens *(figure 11).* In individuals with diabetes or CVR on the other hand, stricter targets (<130/80 mmHg) are strived for, provided they are achievable without significant adverse effects.

<table>
<tr><th>Grading hypertension</th><th>Step 1</th><th colspan="2">Step 2</th></tr>
<tr><td>High normal BP
BP 130-139/85-89mmHg</td><td rowspan="4">Lifestyle advice</td><td colspan="2">Very high risk patients
→ drug treatment</td></tr>
<tr><td>Grade 1 hypertension
BP 140-159/90-99mmHg</td><td>High or very high risk patients
→ drug treatment</td><td>Low moderate risk patients
→ drug treatment if BP uncontrolled after 3-6 months of lifestyle interventions</td></tr>
<tr><td>Grade 2 hypertension
BP 160-179/100-109mmHg</td><td colspan="2" rowspan="2">Immediate drug treatment in all patients with aim for BP control within 3 months</td></tr>
<tr><td>Grade 3 hypertension
BP ≥180/110mmHg</td></tr>
</table>

Figure 10: Treatment initiation for hypertension

Population	Initial Target	If Tolerated
Most adults	<140/90 mmHg	Aim for <130/80 mmHg
Elderly (≥65 years)	<140/90 mmHg	SBP 130–139 mmHg
Diabetes/high CV risk	<130/80 mmHg	Avoid <120/70 mmHg

Figure 11: Hypertension diagnostic thresholds

Hypertension is classified as resistant if BP remains above target despite adherence to a triple regimen, including a diuretic, at optimal doses. In such cases, adherence should be reassessed and secondary causes excluded.

Lifestyle Interventions

Lifestyle interventions should be implemented in all patients with hypertension regardless of the choice for drug treatment, including salt reduction, weight loss, regular physical activity, moderation of alcohol intake, adherence to a Mediterranean diet, and smoking cessation.

Pharmacological Therapy

Pharmacological treatment options include angiotensin-converting enzyme inhibitors (ACEi), angiotensin II receptor blockers (ARBs), calcium channel blockers (CCBs), and thiazide-like diuretics (TZDs). Beta-blockers (BBs) are reserved for specific clinical indications such as ischemic heart disease and heart failure (HF). Spironolactone is recommended as an add-on treatment for resistant hypertension and in patients with HF. Initial treatment should generally consist of dual therapy, preferably as a single-pill combination, typically combining an ACEi or ARB with either a CCB or a diuretic. If BP targets remain unmet, a third drug can be added to form triple therapy: ACEi or ARB combined with a CCB and a diuretic. A fourth agent (such as spironolactone, a beta-blocker, or an alpha-

blocker) may be introduced based on the patient's profile. Certain patient groups may benefit from tailored regimens (*see figure 12*).

Monitoring and Follow-up

During follow-up, regular assessment of medication adherence, treatment efficacy and side effects is required. At-home BP monitoring should be used to assess BP control. Every 1-2 years an evaluation of CVR and organ damage (HMOD) should be performed in patients with uncomplicated hypertension, and more often in high-risk patients either when BP deteriorates. This assessment should include an ECG (and possibly echocardiography), a blood draw (eGFR, creatinin) and urine sample (UACR). Depending on individual risks, additional examinations can be performed: fundoscopy in patients with T2DM or BP ≥180/110mmHg), the vasculature (ankle-brachial index (ABI) in patients with claudication and/or carotid doppler in very high-risk individuals) and the brain (cognitive screening in patients ≥65 years of age).

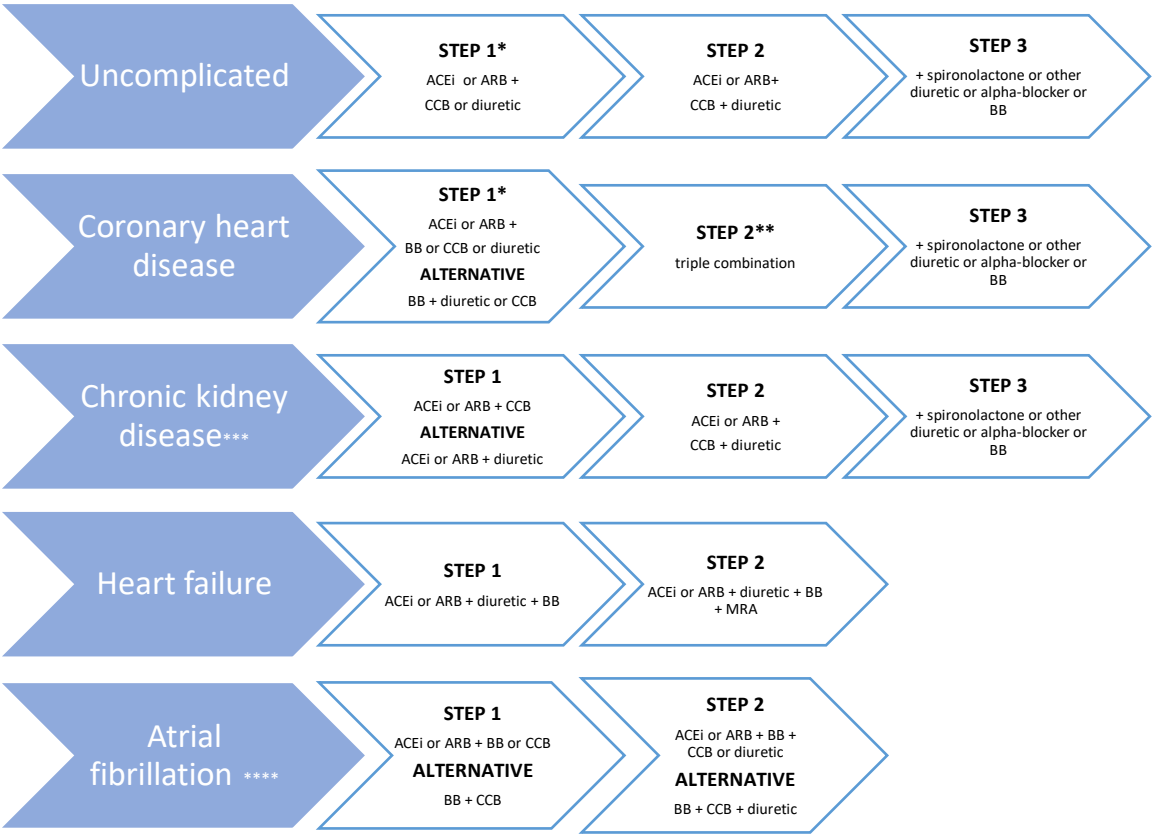


Figure 12: Drug treatment algorithm for hypertension

(*) Consider starting monotherapy in low-risk patients with SBP<150mmHg or frail eldery ≥80y

(**) Consider initiating step 2 when SBP ≥130mmHg in these very high risk patients

(***) A reduction in eGFR and rise in serum creatinine is to be expected when starting antihypertensive treatment (a rise of 30% needs further evaluation)

(****) Oral anticoagulation is to be added when indicated according to the CHA2DS2-VASc score

As knowledge in medicine keeps rapidly expanding, the need for readily available, actionable, clear overviews of medical research becomes increasingly essential. Summarised evidence-based recommendations can be found in clinical guidelines that are readily available and constantly assessed (e.g., GRADE system **[26]**). Nevertheless, a significant gap remains between guidelines and their real-world application in clinical practice. With this study, we aim to identify reasons for (non-)adherence to guidelines in two GP practices.

Methods

Study Design and Population

This non-interventional, observational, cross-sectional study assesses adherence to the 2022 EASD guidelines for type 2 diabetes mellitus (T2DM) and the 2018 ESC/ESH guidelines for hypertension among 6 GPs in two Belgian primary care practices (located in Schoten and Zoersel). Both practices used CareConnect by Corilus as their electronic health record (EHR) system.

Inclusion criteria

All adults (≥18 years) with a coded diagnosis of T2DM (excluding gestational diabetes) or hypertension were included. Additionally, because of insufficient coding rates, all adults meeting diagnostic criteria for hypertension or T2DM were included as follows:

- Hypertension: systolic BP ≥140 mmHg and/or diastolic BP ≥90 mmHg (as manually entered by GPs in patient records).
- T2DM: fasting plasma glucose (FPG) ≥126 mg/dL or HbA1c ≥6.5% (laboratory-confirmed).

Patients with incomplete records (e.g., missing BP data) were excluded.

Study population

In Schoten, we included 401 T2DM patients and 663 hypertension patients. In Zoersel, 149 T2DM patients and 763 hypertension patients were included.

Data collection

We conducted retrospective EHR audits in CareConnect, extracting:

- Demographics: age, sex.
- Glycemic measures: FPG, HbA1c (+ frequency of measurements).
- Anthropometrics: BMI
- Kidney function: eGFR, UACR (+ frequency of measurements).
- Lipid profile: LDL (+ frequency of measurements).
- Cardiovascular risk as calculated automatically by CareConnect
- Treatment patterns: medication prescription data
- Comorbidities/complications

Data were anonymized and stored on a password-protected computer and external drive, compliant with ethical guidelines.

Analysis

Data was approached in a descriptive manner, analysed by measures of mean, median, standard deviation (SD) and interquartile range (IQR). Additionally, frequency of measurements in the patient population were described. The extent of guideline adherence was deflected from the results of this analysis, as well as the extent to which clinical inertia was present, defined as patients fulfilling the diagnostic criteria for hypertension or diabetes, but who remain untreated. Data were processed in RStudio.

Ethical Considerations

Approval by an ethics committee (Ethische Commissie UZ KU Leuven) was waived per Belgian law for retrospective anonymized data analyses within the participating practices. Data were aggregated to ensure non-identifiability.

Results

Results for Type 2 Diabetes Mellitus (T2DM) data

Demographics

A total of 401 patients with T2DM were included from the Schoten general practice, of whom 230 (57,4%) were male. In the Zoersel general practice, 149 patients were included, with 86 males (57,7%). The mean age in the Schoten cohort was 71,7 years (SD 13,1), and 70,9 years (SD 15) in the Zoersel cohort. Data regarding race/ethnicity and socioeconomic status were not available for either population (s*ee figure 13).*

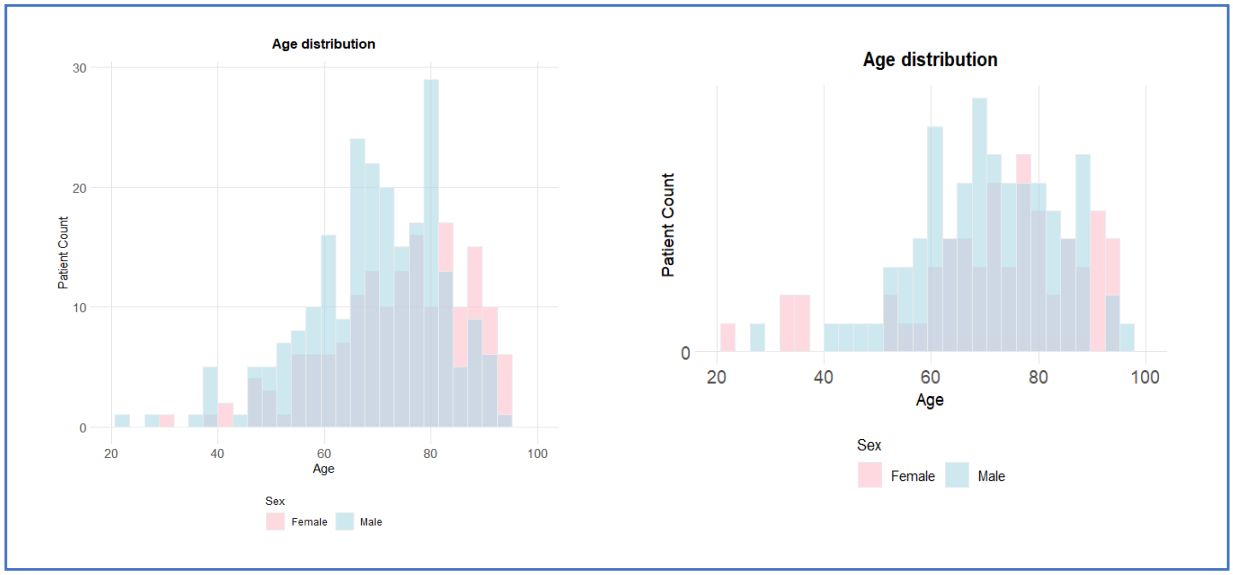


Figure 13: Demographic characteristics for T2DM patients in Schoten (left) and Zoersel (right).

BMI

Body mass index (BMI) data were available for 114 patients (28,4%) in Schoten and 23 patients (15,4%) in Zoersel. The mean BMI in Schoten was 28,3 kg/m² (SD 4,8; range 17–39,5) and 27.8 kg/m² (SD 5,5; range 19–40) in Zoersel (*see figure 14*).

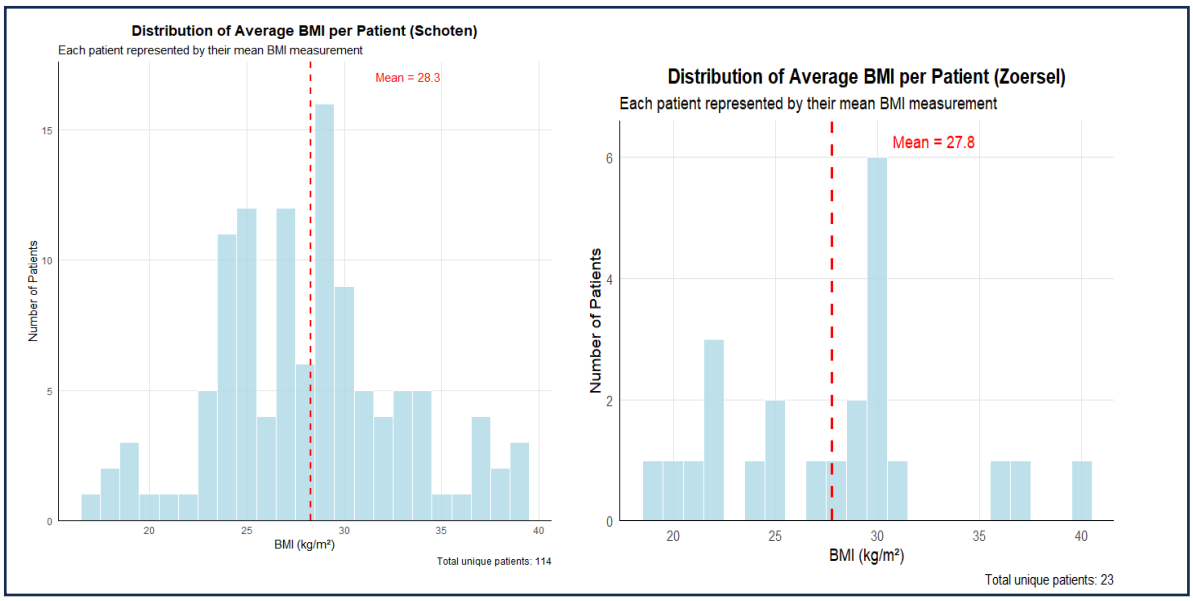
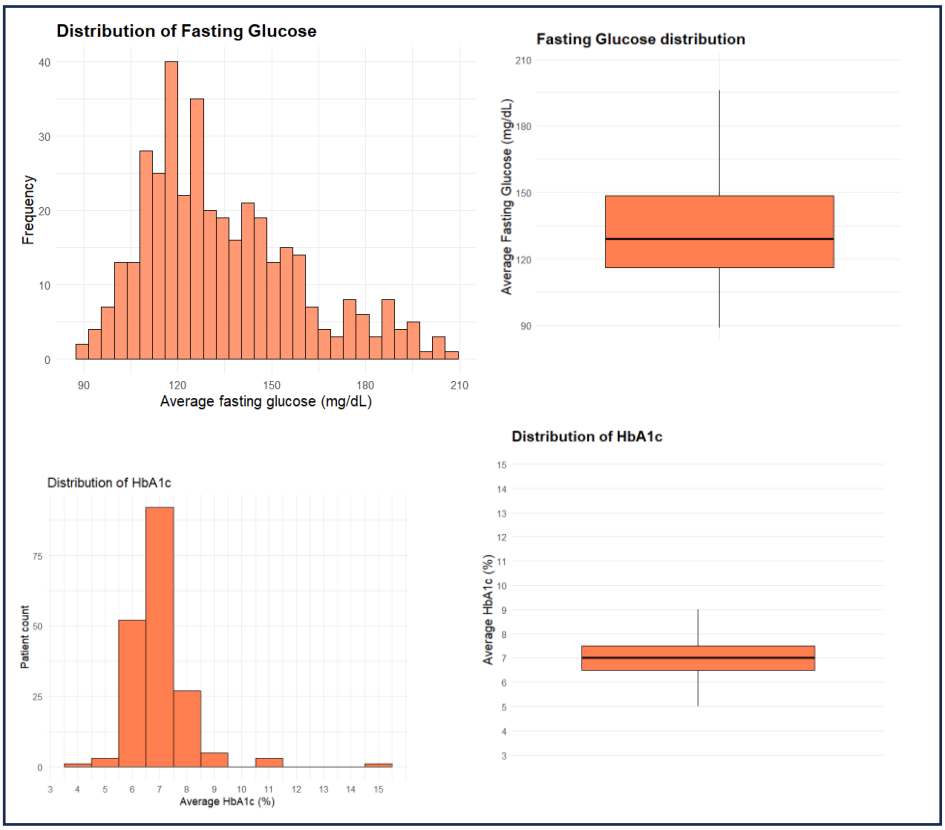


Figure 14: BMI distribution in Schoten (left) and Zoersel (right) population for T2DM population

Glycemic Control

The mean FPG value was 130 mg/dL (SD 42,6) in Schoten and 132 mg/dL (SD 44,1) in Zoersel (*figure 15*). Systematic monitoring of glycemic control through HbA1c was limited in both practices; in Schoten, fewer than 2% of patients underwent HbA1c testing at three-month intervals, and no patients in Zoersel received such regular monitoring. The mean interval between two HbA1c measurements was 242 days (median: 124) in Schoten and 271 days (median: 170) in Zoersel.



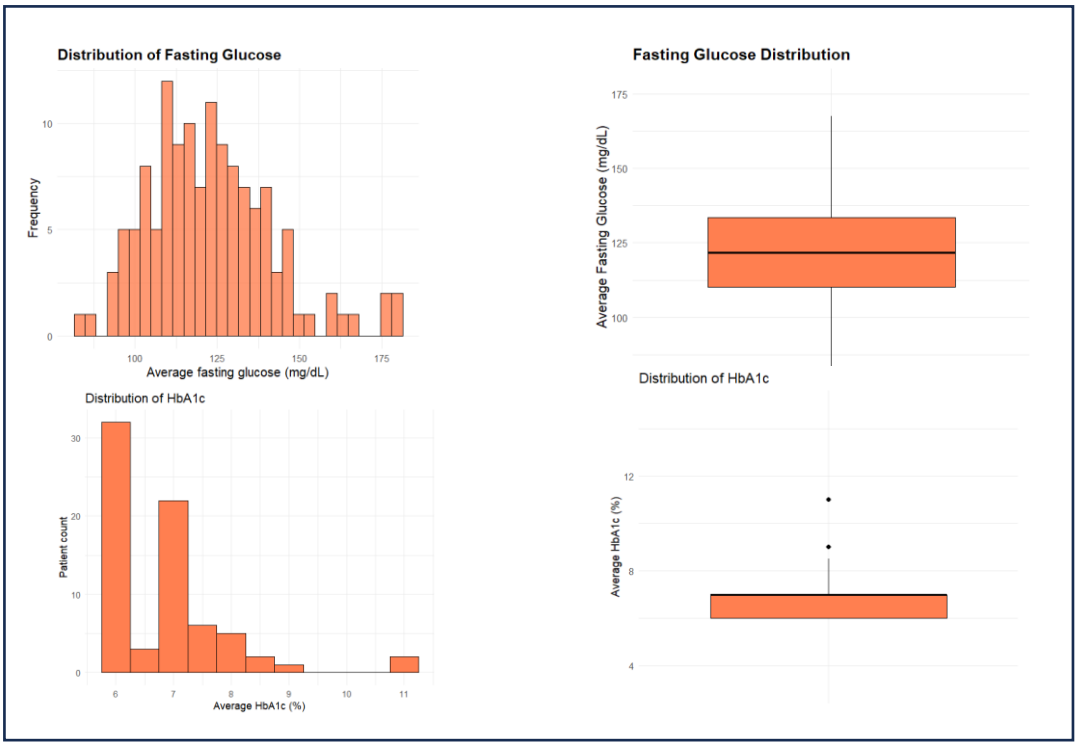
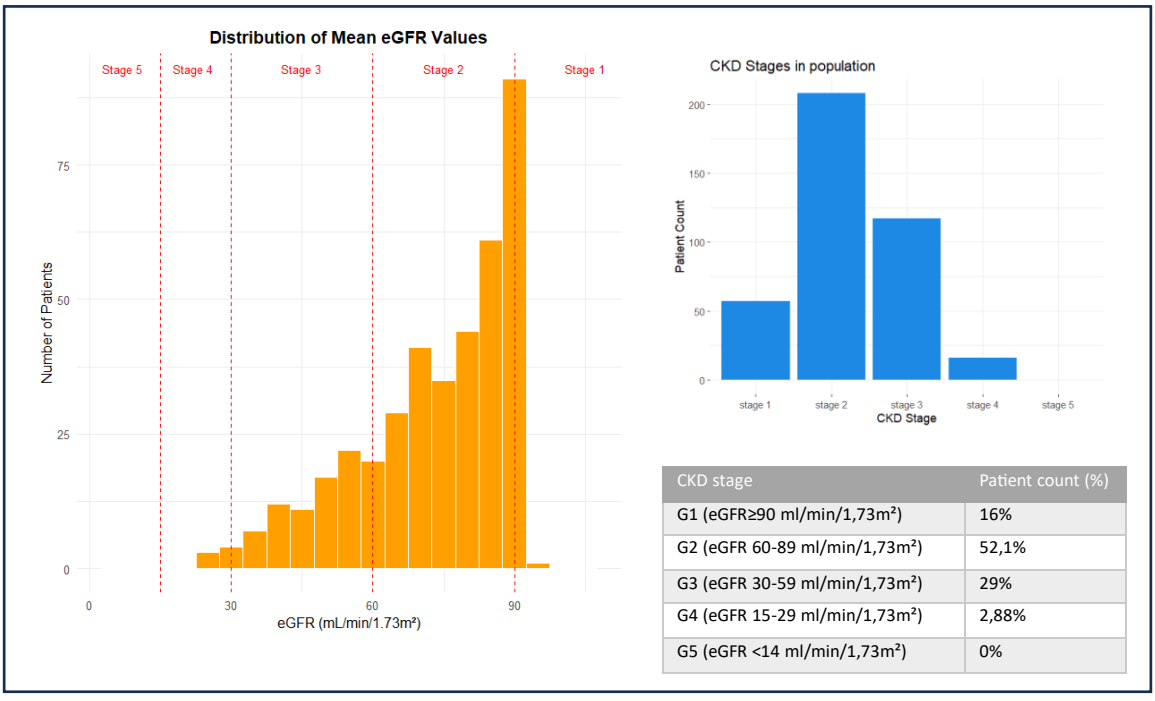


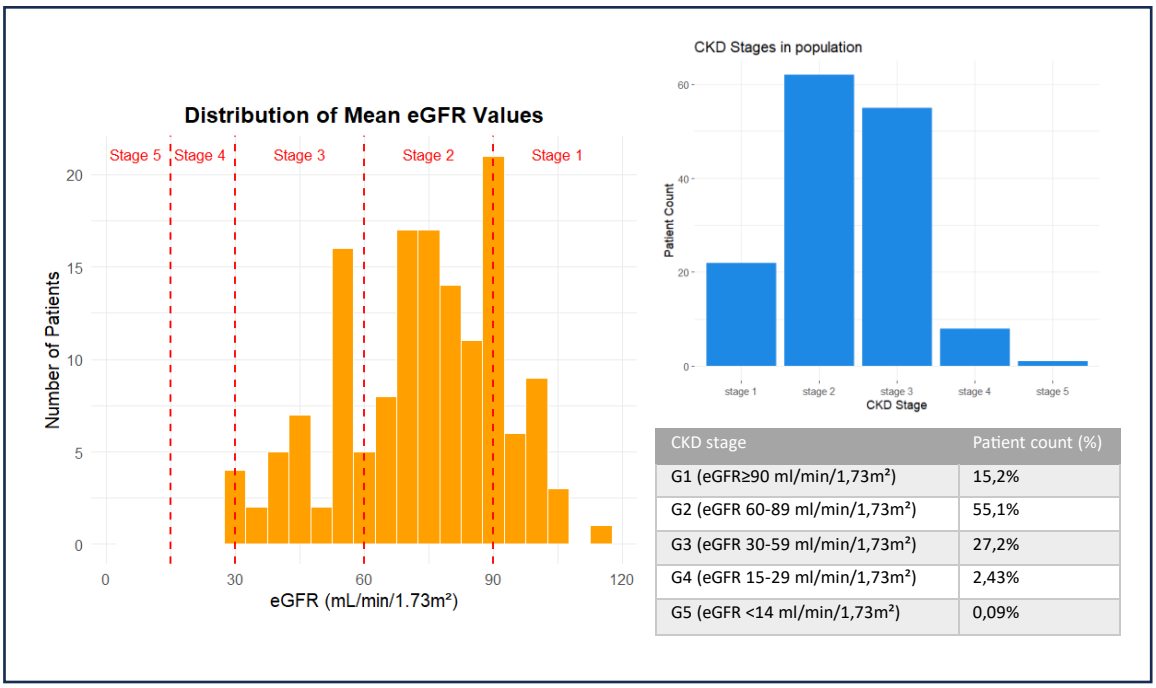
Figure 15: Glycemic parameters in Schoten (upper) and Zoersel (lower) practices

Renal Function

In Schoten, 219 patients (54,6%) received at least one annual estimated glomerular filtration rate (eGFR) assessment. Overall, 373 patients (93%) had at least one eGFR test, and 308 (76,8%) underwent multiple assessments, though not annually. In Zoersel, only 7 patients (4,6%) had annual eGFR testing. Nonetheless, 148 patients (99,3%) had at least one measurement, and 134 patients (89,9%) had multiple assessments, again with no annual consistency. See *figure 16* showing the distribution of CKD stages in the populations.



CKD stage	Patient count (%)
G1 (eGFR≥90 ml/min/1,73m²)	16%
G2 (eGFR 60-89 ml/min/1,73m²)	52,1%
G3 (eGFR 30-59 ml/min/1,73m²)	29%
G4 (eGFR 15-29 ml/min/1,73m²)	2,88%
G5 (eGFR <14 ml/min/1,73m²)	0%



CKD stage	Patient count (%)
G1 (eGFR≥90 ml/min/1,73m²)	15,2%
G2 (eGFR 60-89 ml/min/1,73m²)	55,1%
G3 (eGFR 30-59 ml/min/1,73m²)	27,2%
G4 (eGFR 15-29 ml/min/1,73m²)	2,43%
G5 (eGFR <14 ml/min/1,73m²)	0,09%

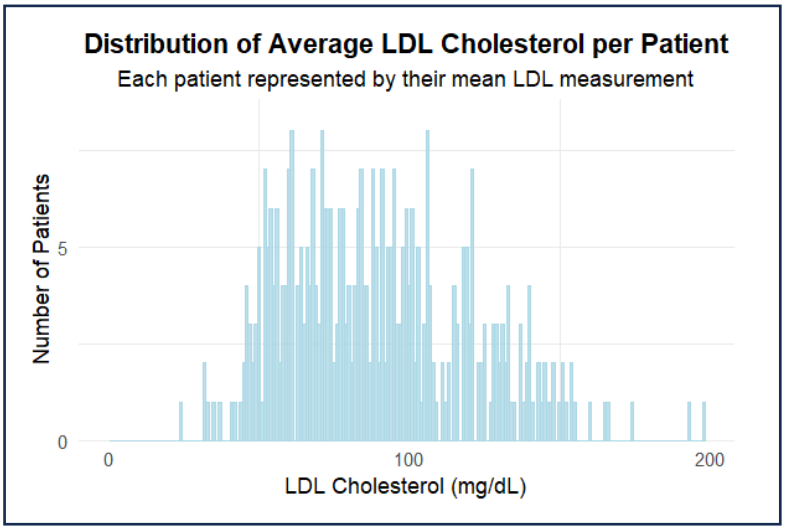
Figure 16: Renal parameters in Schoten (upper) and Zoersel (lower) cohort.

Urine albumin-creatinine ratio

The urine albumin-creatinine ratio (UACR) was assessed in 110 patients (27,4%) in Schoten, with 22 patients undergoing multiple measurements and 14 patients having annual UACR assessments. In Zoersel, UACR measurements were performed in only 19 patients (12,8%), all of whom received only a single measurement during disease follow-up.

Lipid Profile

Monitoring of LDL cholesterol was conducted regularly in both practices. In Schoten, 81% of patients had at least one LDL cholesterol measurement per year, compared to 81.9% in Zoersel. The mean LDL level in Schoten was 85,58 mg/dL (range: 28–198 mg/dL), while in Zoersel it was 100,94 mg/dL (range: 36,2–211 mg/dL). See *figure 17* depicting the LDL-distribution in both practices.



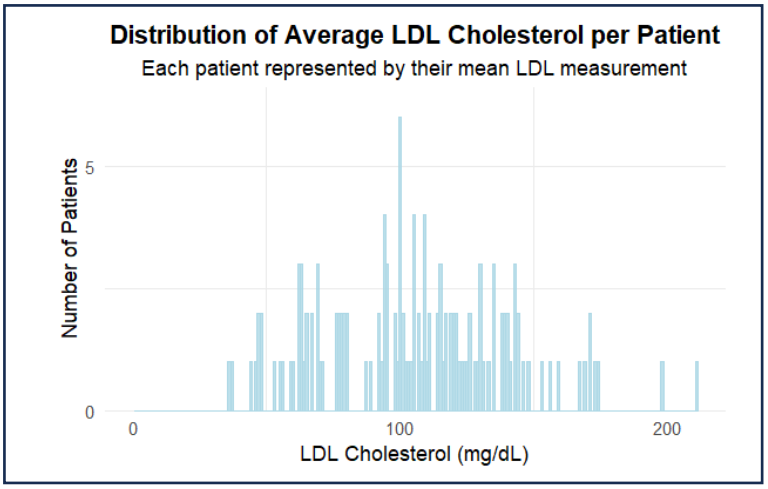
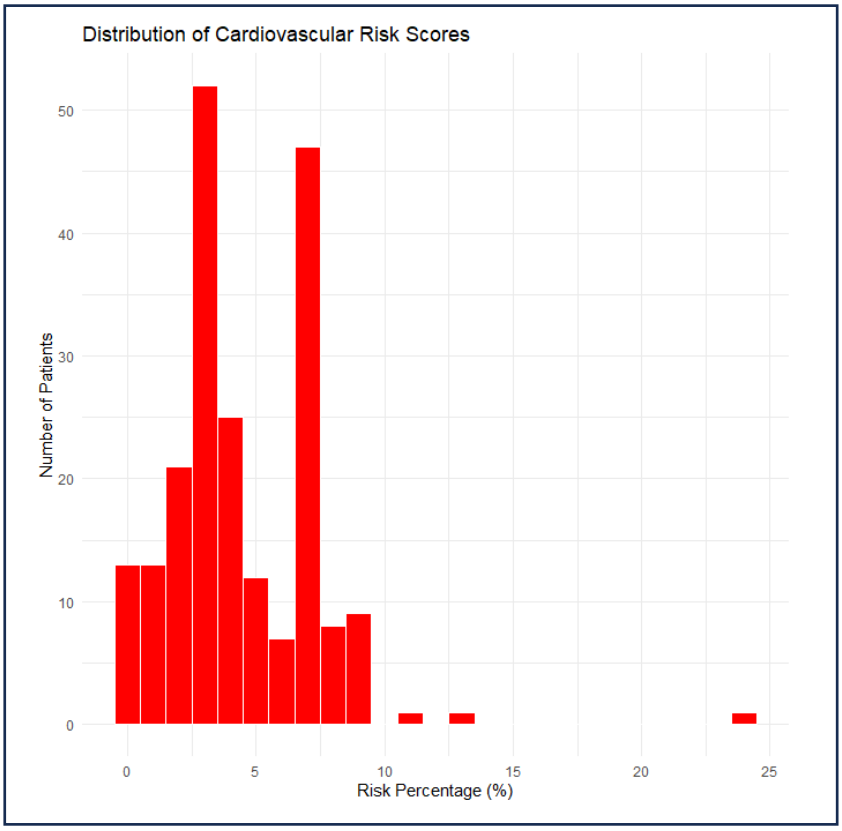


Figure 17: Lipid profile distribution in Schoten (upper) and Zoersel (lower) practices.

Cardiovascular Risk

Cardiovascular risk scores were available for 210 patients (52,3%) in Schoten and 24 patients (16,1%) in Zoersel. In Schoten, the mean estimated 10-year cardiovascular risk was 4.45% (SD 2.91), with a median of 4% and a maximum of 24%. Most patients fell within the 2–7% risk range, with a clear peak around 3–4%. In Zoersel, the mean risk was slightly higher at 5.17% (SD 4.17), with a median of 4% and a maximum of 17%. Despite the smaller sample size, the distribution in Zoersel was broader, with a few patients displaying elevated risk levels above 10%. Overall, both cohorts were characterized by predominantly low to moderate cardiovascular risk scores *(see figure 18).*



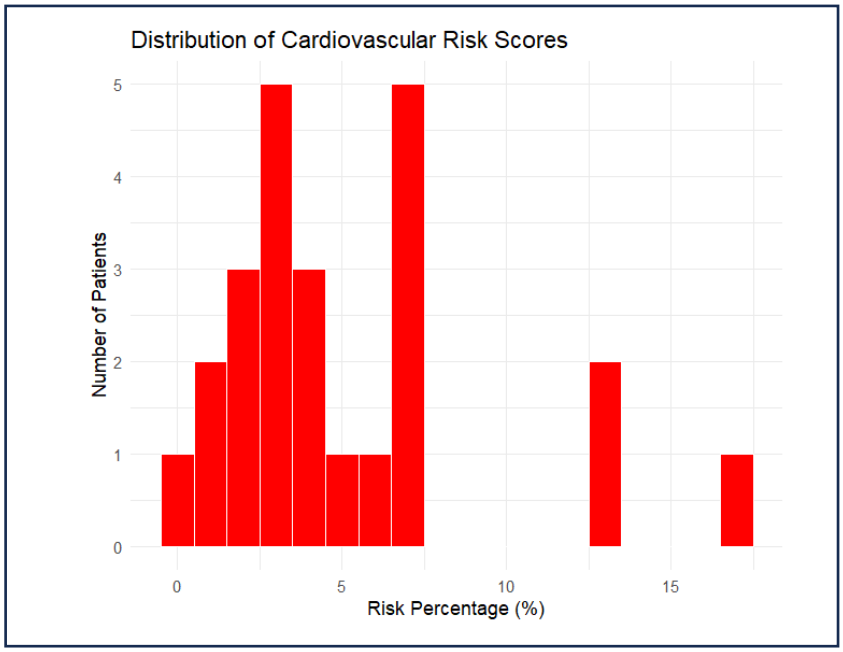


Figure 18: Cardiovascular risk scores in Schoten (upper) and Zoersel (lower) practice.

Antidiabetic Medication and their Use by Comorbidity

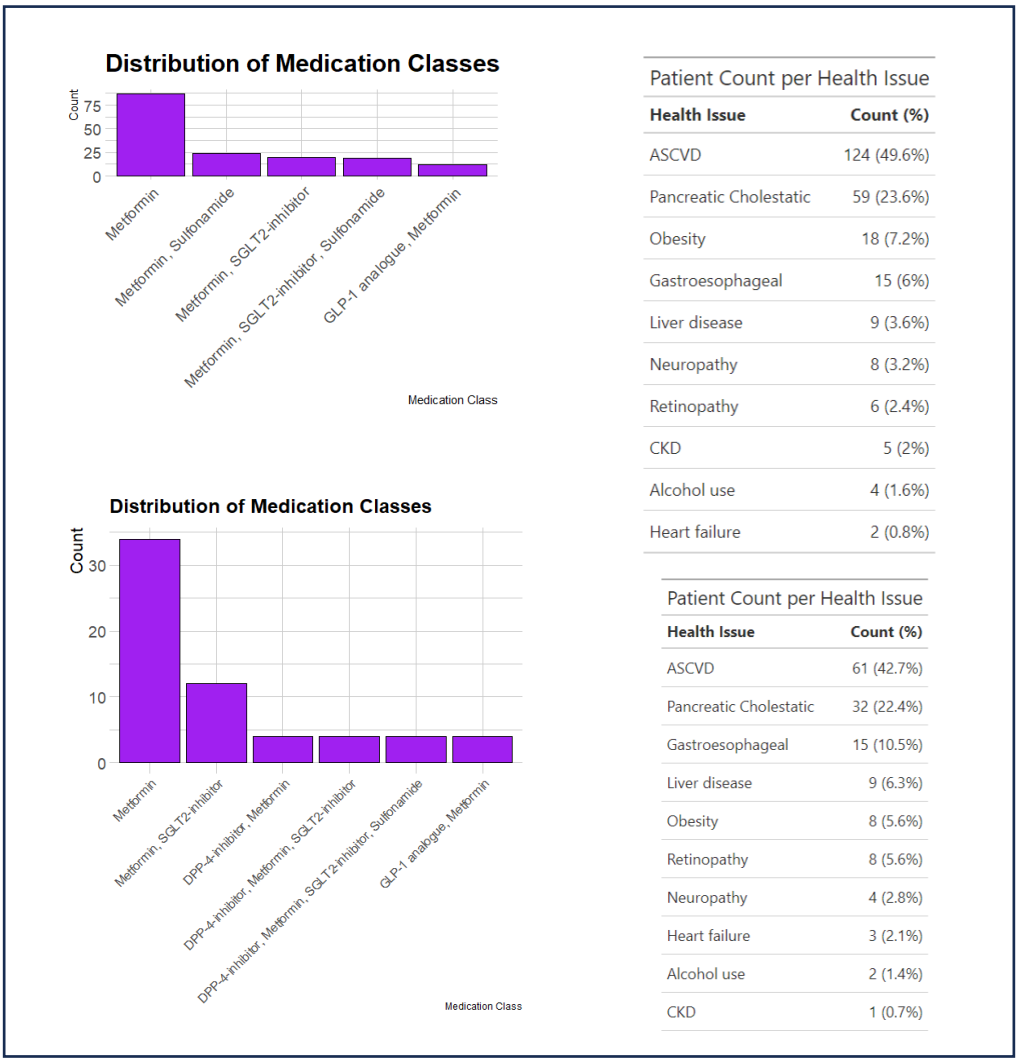
In both Schoten and Zoersel, metformin was the most frequently prescribed glucose-lowering treatment, reflecting its status as the recommended first-line therapy in T2DM, with both practices often choosing for this agent in monotherapy. However, differences were seen between both practices in their choice of second-line therapy. Schoten favoured SU as the primary add-on to metformin in dual therapy, followed by SGLTi as second choice for dual therapy (though the difference in patient count between SU and SGLT2i use was minimal) *(see figure 19).* Zoersel preferred SGLT2i as second-line agent in dual therapy, with no use of SU in bitherapy with metformin. SU only appeared in more advanced treatment regimens (triple or quadruple therapy), likely as an add-on rather than a preferred second-line agent. Additionally, DPP4i were more frequently prescribed in Zoersel than in Schoten. The use of GLP1-RA remained low in both practices.

Figure 19 displays the frequency of coded diagnoses in this population. ASCVD was documented in (49,6%) of T2DM patients in Schoten and 77,9% in Zoersel. Obesity and CKD were significantly underreported in both practices, with Schoten coding obesity in only 7,2% of patients and Zoersel formally recording no patients. CKD was reported in 2% of patients in Schoten and 1,7% in Zoersel. From BMI and CKD statistics we performed, we know that actual prevalences are higher, with obesity occurring in 41,6% of patients in Schoten and in 62,55% in Schoten, though the amount of patients where BMI was registered remained low in both practices (see BMI section) and eGFR <60 mL/min/1,73m² in ~30% of patients in both practices.

Medication prescribing patterns varied by CKD stage (*figure 20*). Across all CKD stages (G1–G4), metformin remained the most commonly used agent, either alone or in combination. However, in more advanced stages (G3–G4), a relative increase in combination therapies, particularly with sulfonylureas and SGLT-2 inhibitors, was observed. Use of GLP1-RA remained limited across stages.

When stratified by complication, patients with atherosclerotic cardiovascular disease (ASCVD) were most frequently treated with metformin monotherapy or combinations involving SGLT-2 inhibitors in both practices, reflecting the guideline recommendations. In contrast, among patients with obesity,

there was a more balanced distribution of treatment regimens, with no clear preference for the use of GLP1-RA or SGLT2i (*figure 20*).



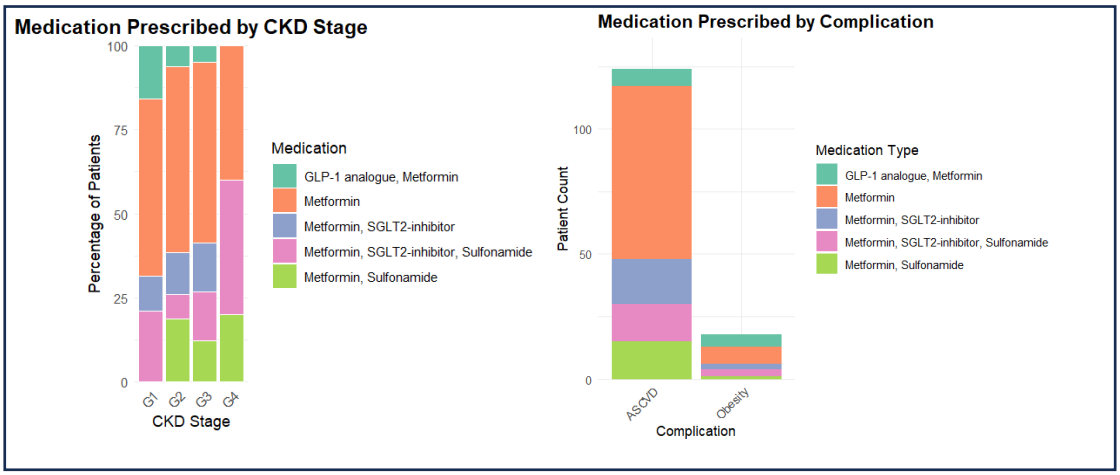
Patient Count per Health Issue

Health Issue	Count (%)
ASCVD	124 (49.6%)
Pancreatic Cholestatic	59 (23.6%)
Obesity	18 (7.2%)
Gastroesophageal	15 (6%)
Liver disease	9 (3.6%)
Neuropathy	8 (3.2%)
Retinopathy	6 (2.4%)
CKD	5 (2%)
Alcohol use	4 (1.6%)
Heart failure	2 (0.8%)

Patient Count per Health Issue

Health Issue	Count (%)
ASCVD	61 (42.7%)
Pancreatic Cholestatic	32 (22.4%)
Gastroesophageal	15 (10.5%)
Liver disease	9 (6.3%)
Obesity	8 (5.6%)
Retinopathy	8 (5.6%)
Neuropathy	4 (2.8%)
Heart failure	3 (2.1%)
Alcohol use	2 (1.4%)
CKD	1 (0.7%)

Figure 19: Antidiabetic medication use and comorbidities in Schoten (upper) and Zoersel (lower) cohorts



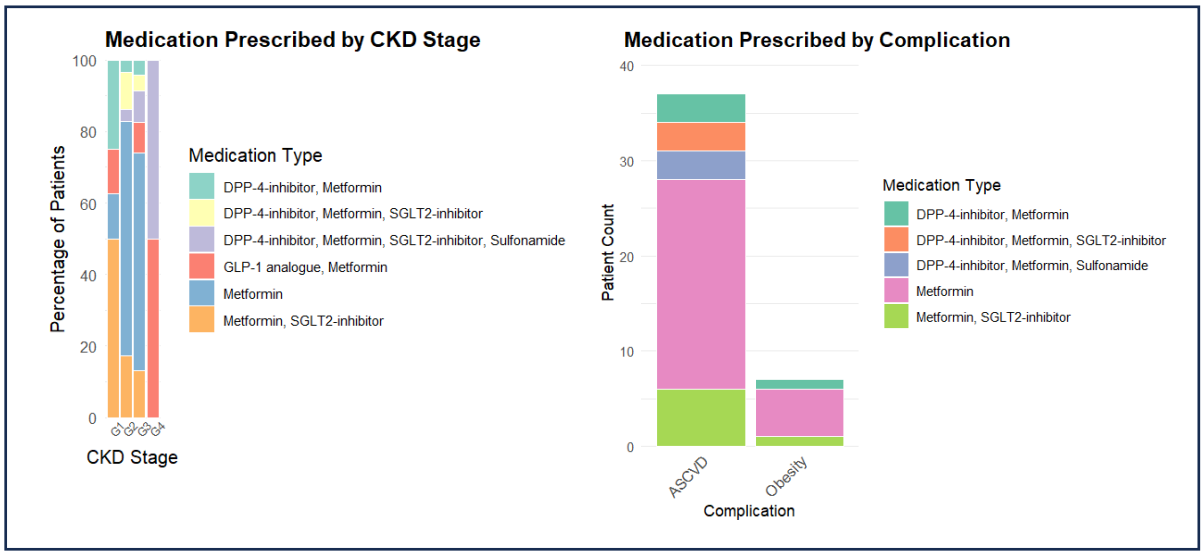


Figure 20: Medication prescription data by CKD and complications for Schoten (upper) and Zoersel (lower)practices

Inertia

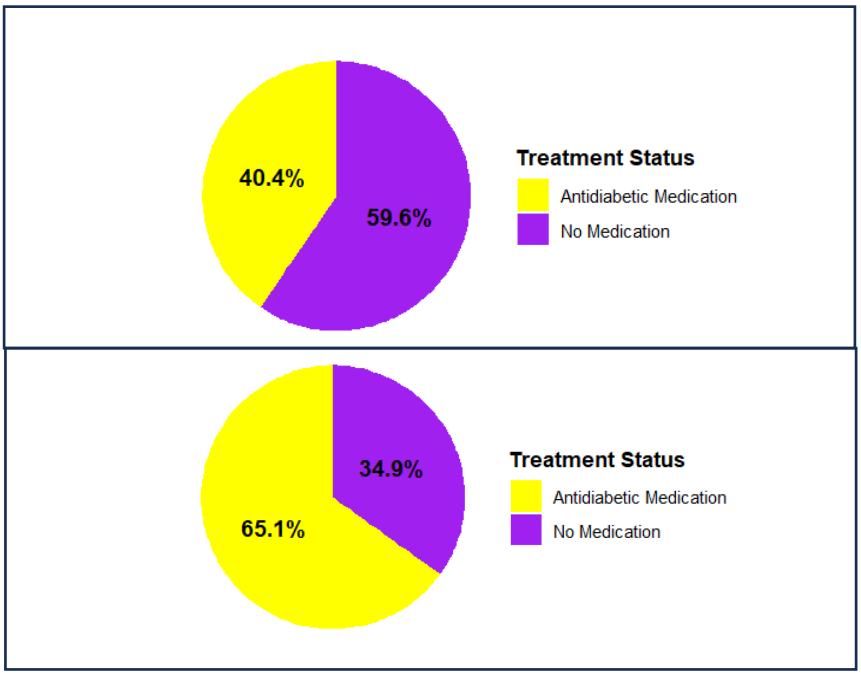


Figure 21: Therapeutic inertia in Schoten (upper) and Zoersel (lower)

A notable difference in therapeutic inertia was observed between both practices for T2DM patients *(figure 21);* in Schoten, only 40% of patients meeting diagnostic criteria were prescribed glucose-lowering medication, while in Zoersel 65,1% of eligible patients received pharmacological treatment.

Results for Hypertension data

Demographic Characteristics

The initial dataset from Schoten included 922 patients with coded diagnosis of hypertension, of whom 450 were male (48,8%). After excluding patients lacking diastolic or systolic blood pressure measurements, 663 patients remained (332 male; 50,1%). In Zoersel, 763 patients were included, with 403 males (52,8%). The mean age in Schoten was 70 years (SD 15,3), while in Zoersel it was 67,1 years (SD 16,2). As with the diabetes population, data on race/ethnicity and socioeconomic status were unavailable (see *figure 22*)

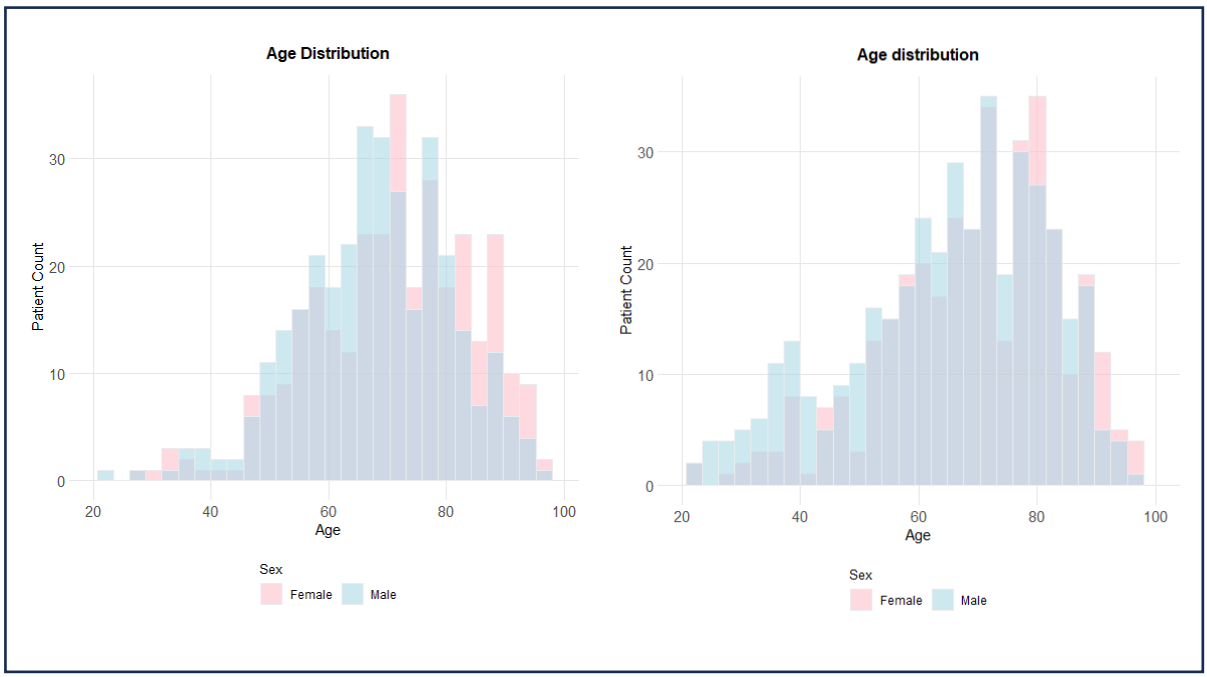


Figure 22: Demographic characteristics for the hypertension cohort in Schoten (left) and Zoersel (right)

BMI

BMI data *(figure 23)* were available for 185 patients (20,0%) in Schoten and 363 patients (47,6%) in Zoersel. In Schoten, the mean BMI was 29.3 kg/m² (SD 4,83; range: 19–48), whereas in Zoersel the mean BMI was 28,4 kg/m² (SD 5,6; range: 16,1–49,7).

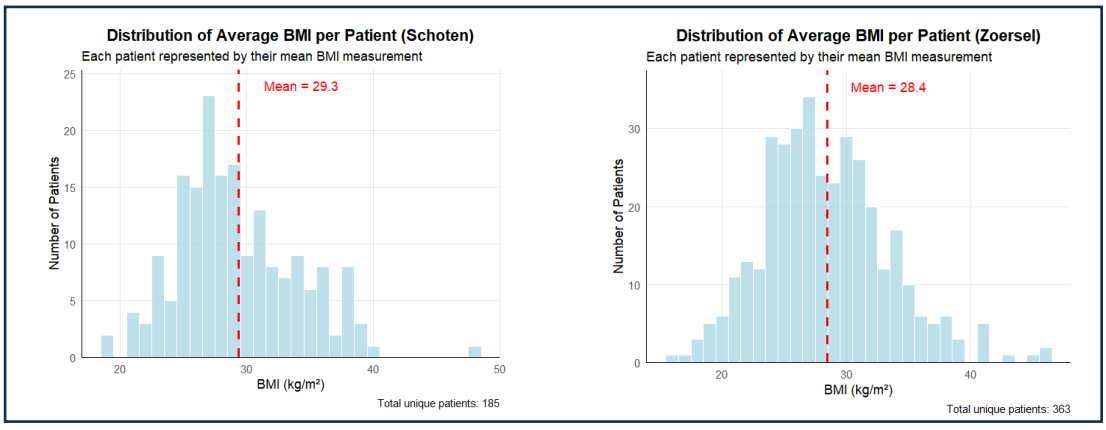


Figure 23: BMI distribution in Schoten (left) and Zoersel (right) population for hypertension analysis

Blood Pressure

The mean systolic blood pressure (SBP) in Schoten was 132 mmHg (SD 16,9) and the mean diastolic blood pressure (DBP) was 78,4 mmHg (SD 10). The majority of patients exhibited high-normal blood pressure, with decreasing prevalence in higher hypertension stages. In contrast, Zoersel patients had a mean SBP of 139 mmHg (SD 14,8) and a mean DBP of 82,9 mmHg (SD 19), with most patients classified as having grade 1 hypertension (see *figure 24*).

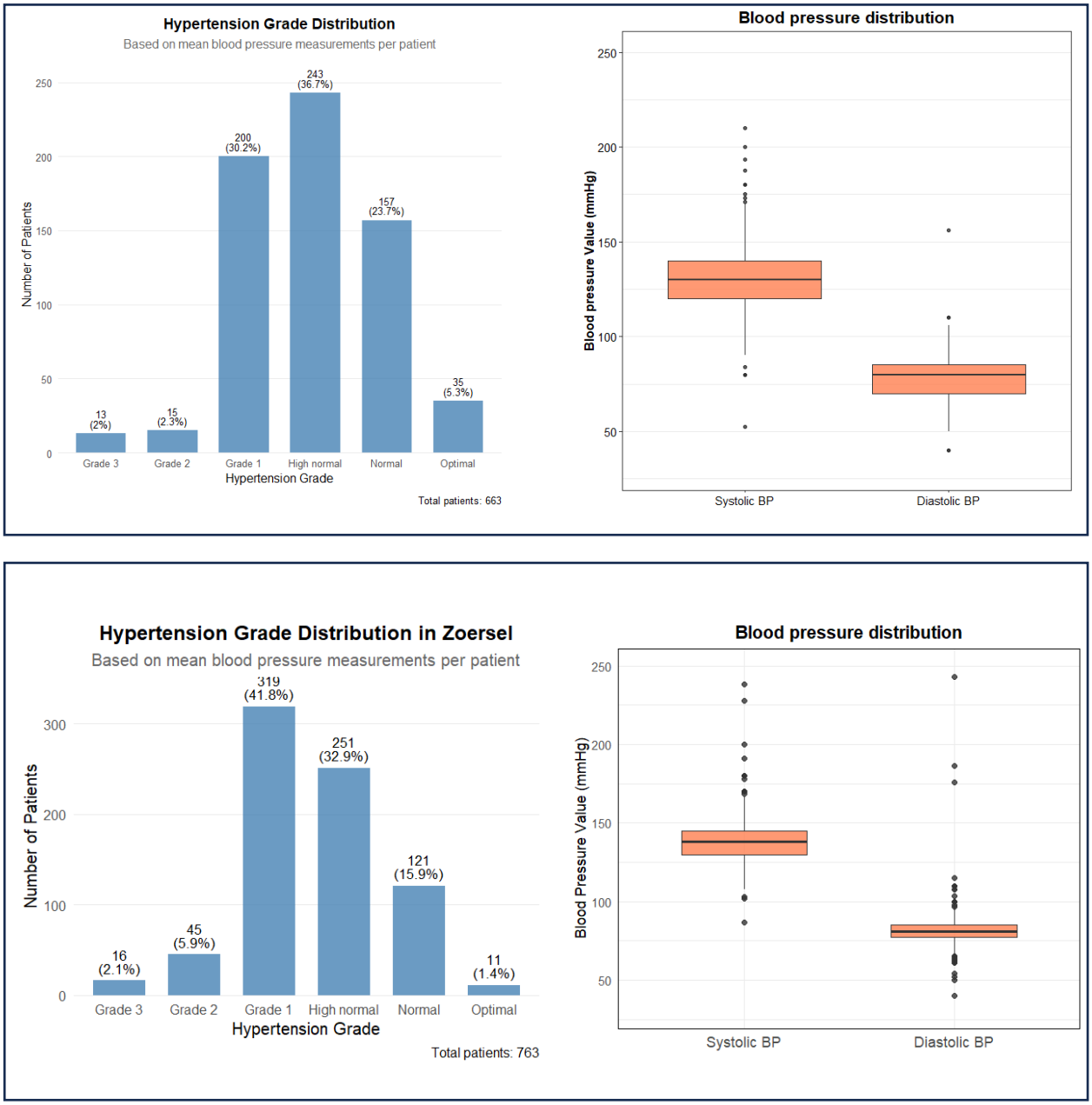


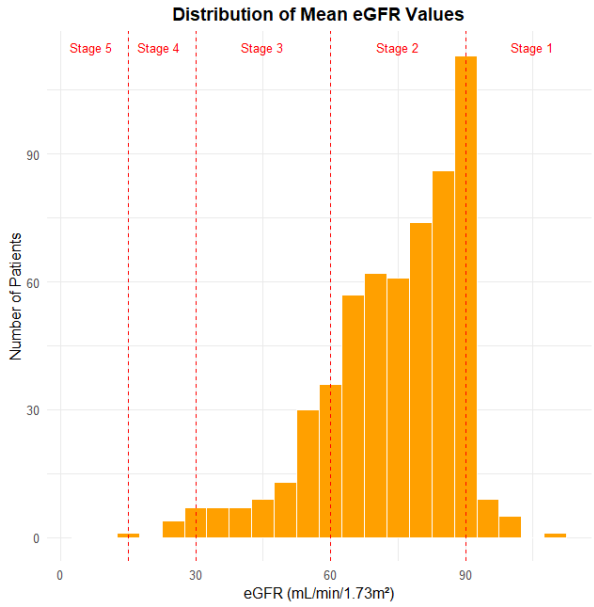
Figure 24; Blood pressure statistics for Schoten (upper) and Zoersel (lower) practices

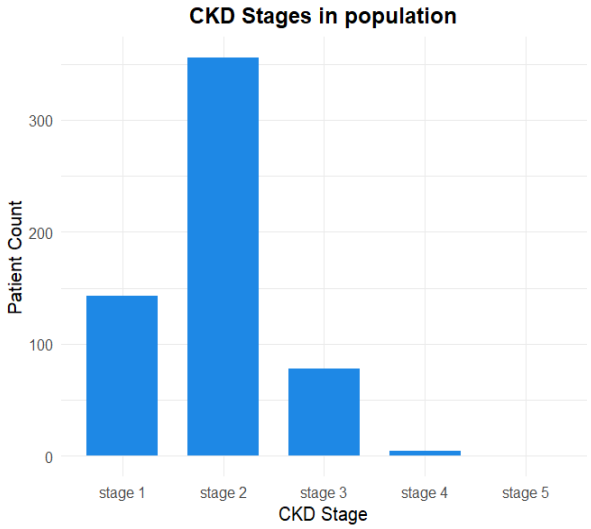
Albuminuria

Urinary albumin-to-creatinine ratio (UACR) was measured in 63 patients (0,1%) in Schoten, with 10 patients undergoing multiple assessments and 6 receiving annual measurements. In Zoersel, UACR was measured in 30 patients (0,04%), with 7 having multiple measurements and only 3 tested annually.

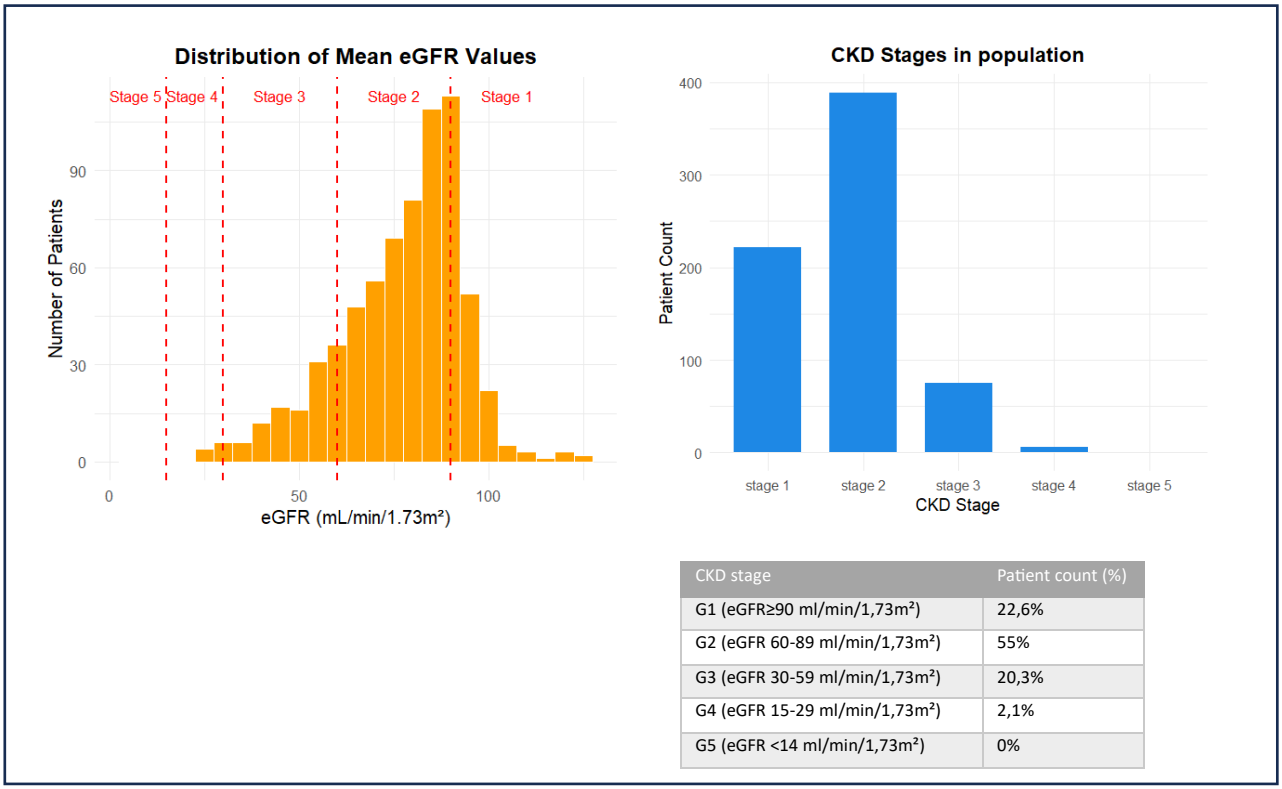
Renal Function

Annual eGFR testing was performed in 219 patients (54,6%) in Schoten. In total, 373 patients (93,0%) underwent at least one eGFR test, and 308 (76,8%) had multiple measurements, though these were not conducted annually. In Zoersel, 23 patients (3,6%) received annual eGFR assessments, whereas 692 (90,7%) had at least one measurement and 642 (84,1%) underwent multiple assessments, again not on an annual basis (*see figure 25*).





CKD stage	Patient count (%)
G1 (eGFR≥90 ml/min/1,73m²)	15,2%
G2 (eGFR 60-89 ml/min/1,73m²)	58,3%
G3 (eGFR 30-59 ml/min/1,73m²)	22,2%
G4 (eGFR 15-29 ml/min/1,73m²)	3,79%
G5 (eGFR <14 ml/min/1,73m²)	0%



CKD stage	Patient count (%)
G1 (eGFR≥90 ml/min/1,73m²)	22,6%
G2 (eGFR 60-89 ml/min/1,73m²)	55%
G3 (eGFR 30-59 ml/min/1,73m²)	20,3%
G4 (eGFR 15-29 ml/min/1,73m²)	2,1%
G5 (eGFR <14 ml/min/1,73m²)	0%

Figure 25: Renal parameters for Schoten (upper) and Zoersel (lower) hypertension populations

Lipid Profile

LDL-cholesterol monitoring *(figure 26)* adherence remained high in both practices. In Schoten, 81% of patients received at least one LDL measurement annually, compared to 78,8% in Zoersel. The mean LDL cholesterol level was 104 mg/dL (SD 31,5) in Schoten and 110 mg/dL (SD 31,4) in Zoersel.

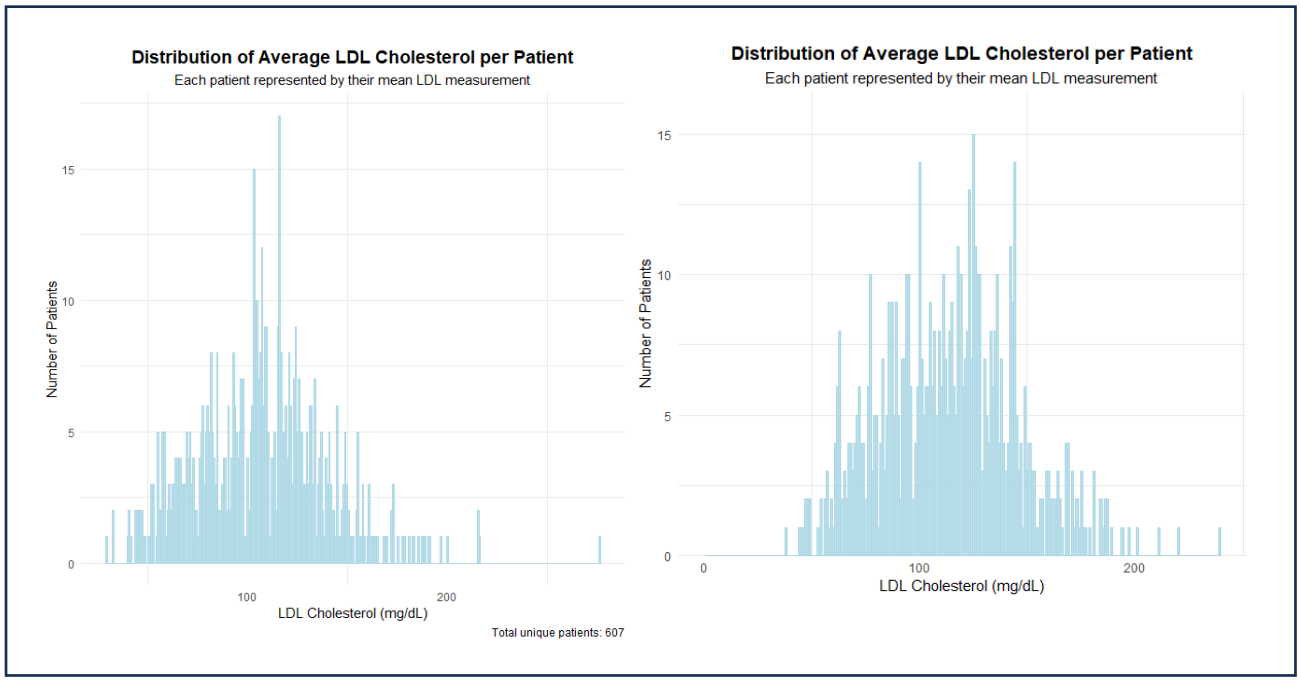


Figure 26: Lipid profile for Schoten (left) and Zoersel (right) for hypertension data

Cardiovascular Risk Assessment

In Schoten, cardiovascular risk scores were available for 448 patients (67,6%). The mean risk score was 5,41% (SD 3,75), with a median of 5%. In Zoersel, risk scores were available for 147 patients (19,3%), with a mean of 4,45% (SD 3,62) and a median of 3%. The distribution in both populations was similar, with most patients having risk scores <10% *(see figure 27).*

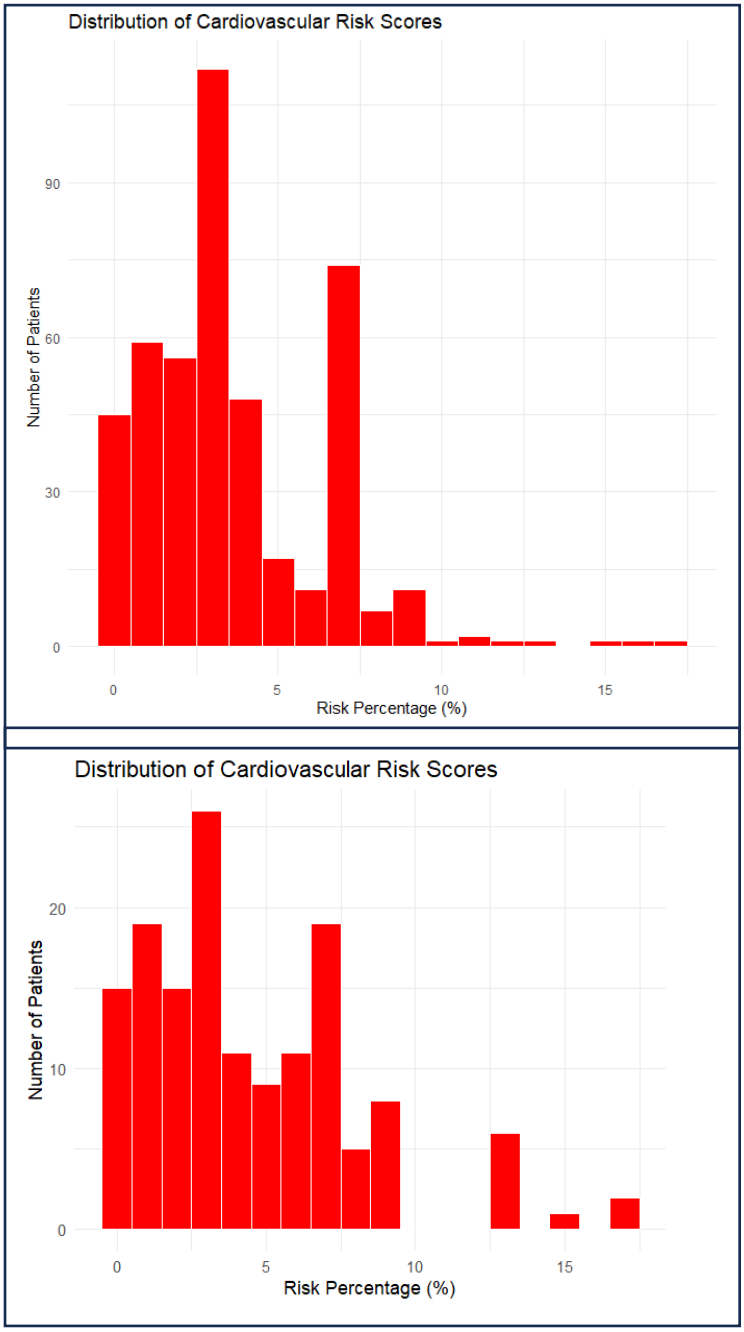


Figure 27: Cardiovascular risk distribution for Schoten (upper) and Zoersel (lower) hypertension population

Medication for Hypertension and Use per Comorbidity

In Schoten, the most frequently prescribed combination therapy for hypertension was quadruple therapy consisting of an ARB + CCB + BB + diuretic. The second most prescribed combination was ACEi + CCB, while the third most common regimen was ACEi + BB + CCB + diuretic. In Zoersel, a stronger

preference for ACEi over ARB is apparent, with the most prescribed combination being ACEi + CCB, followed by ACEi + BB + CCB + diuretic (second choice). The third most prescribed medication was ACEi alone.

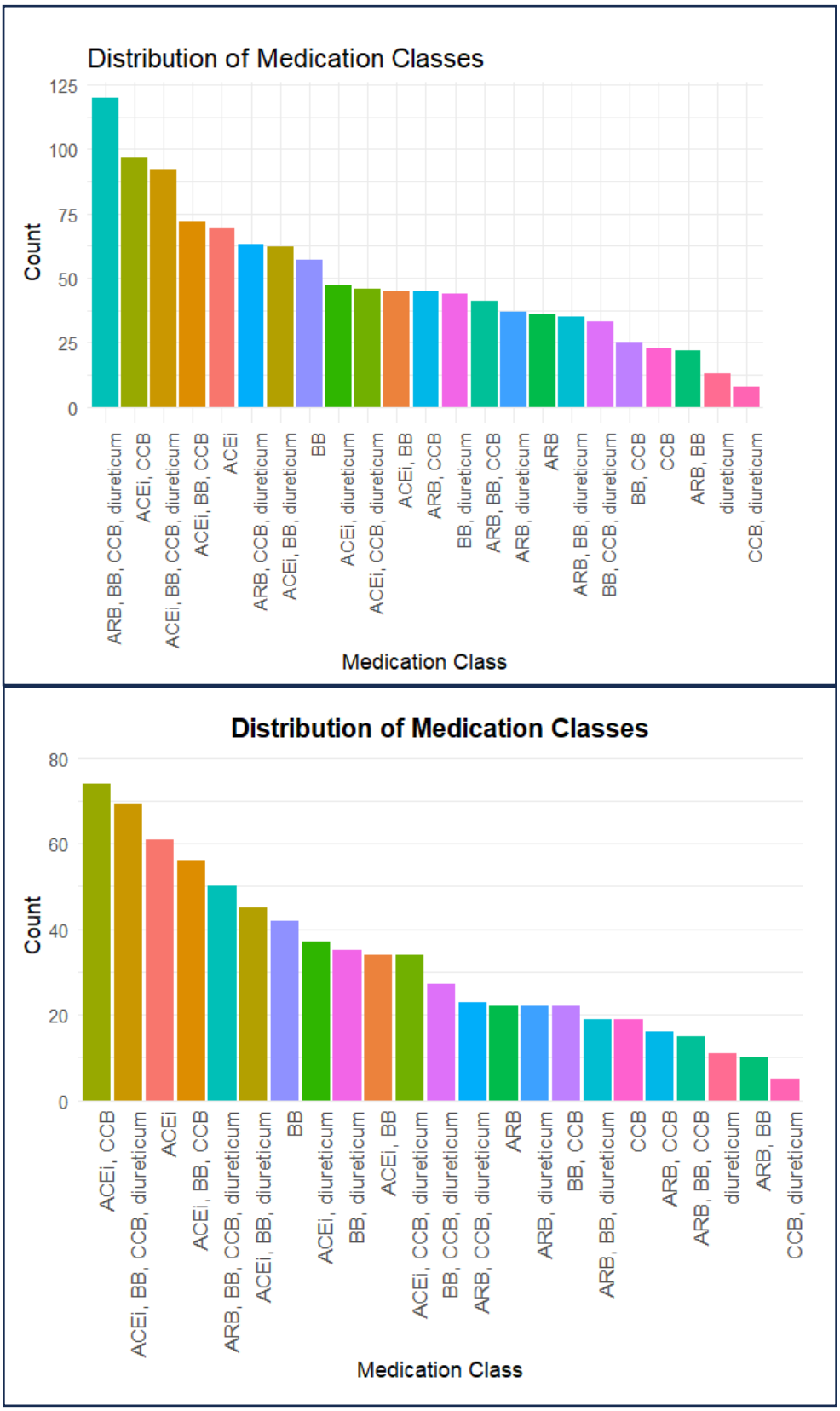
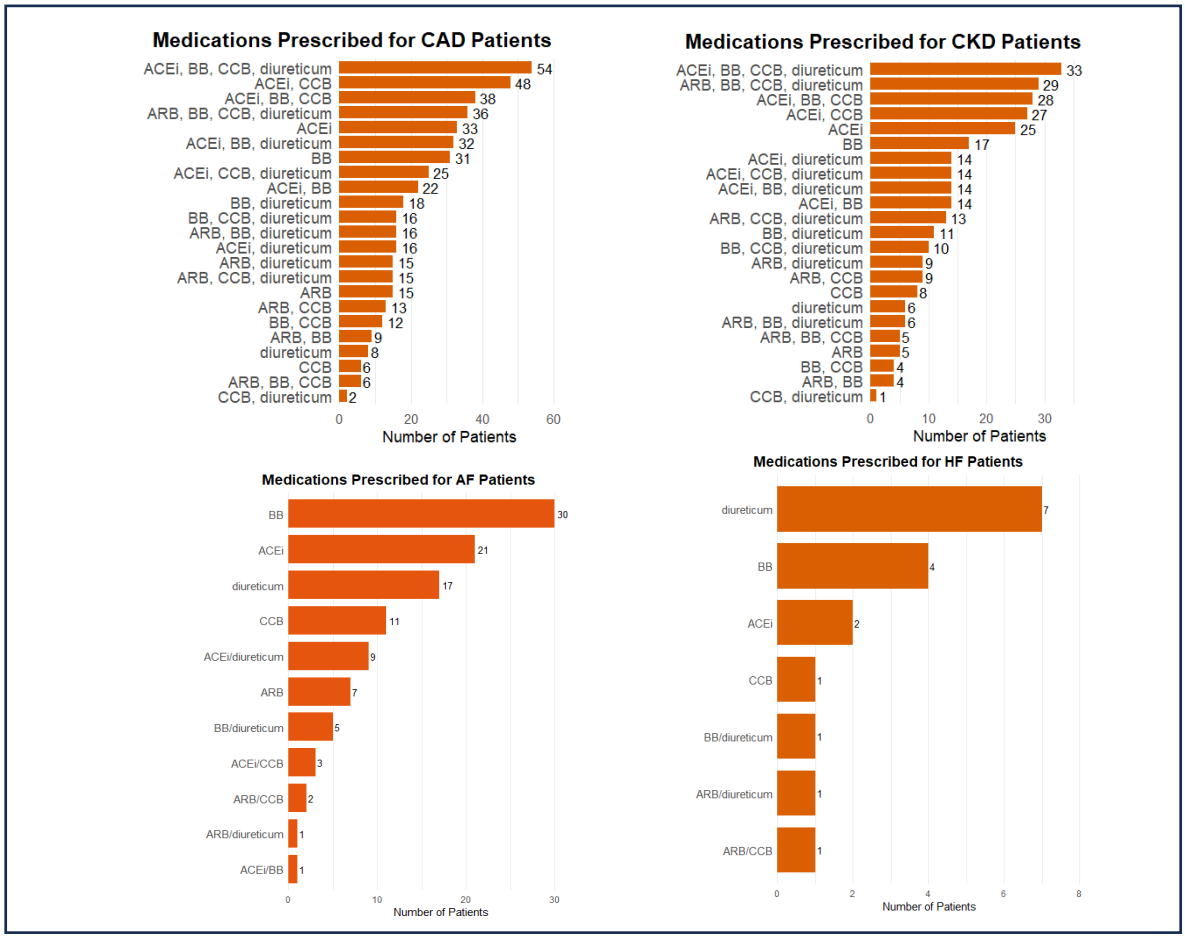


Figure 28: Prescription data for hypertensive patients in Schoten (upper) and Zoersel (lower)



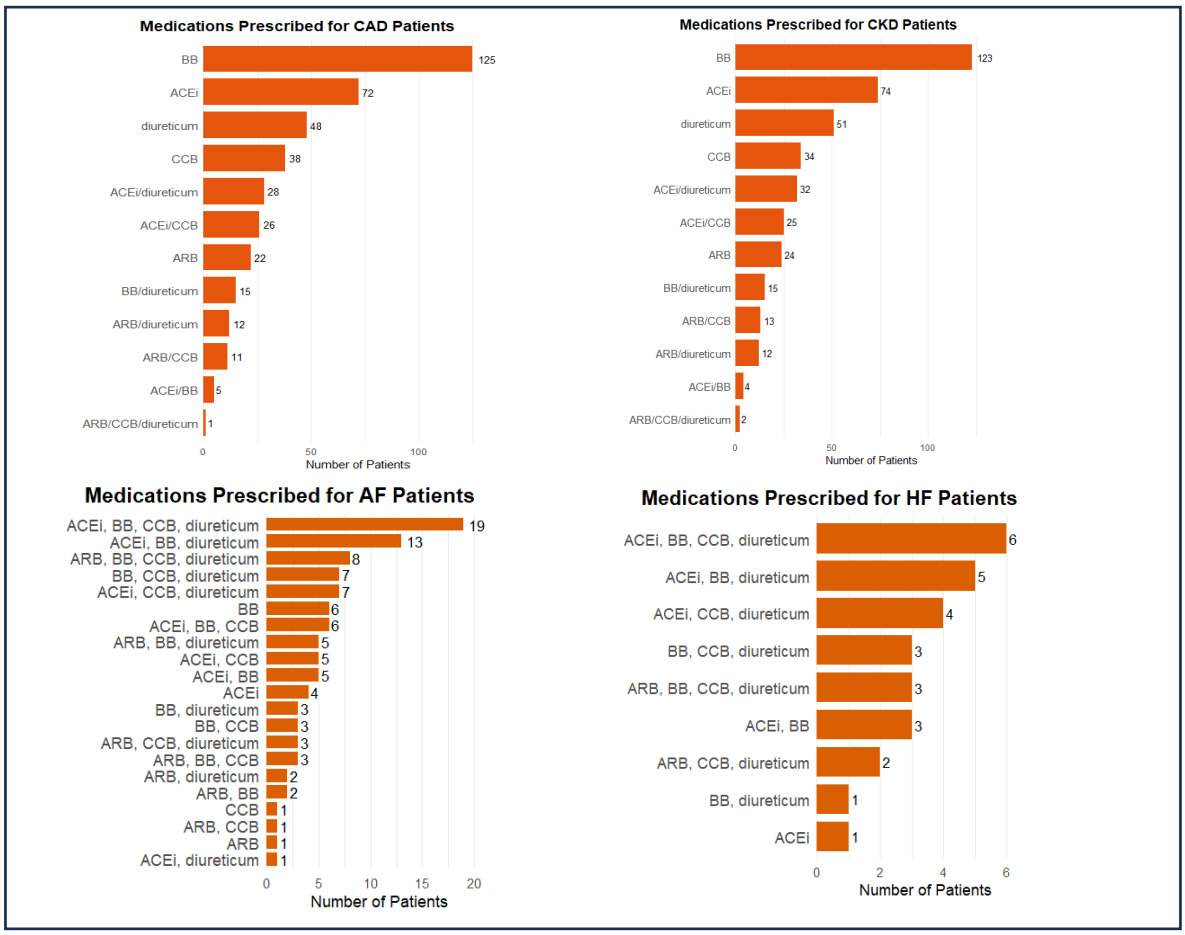


Figure 29: Antihypertensives prescribed per comorbidity in Schoten (upper) and Zoersel (lower) practices

Inertia

Both practices demonstrated minimal therapeutic inertia in hypertension management (*figure 30*) with Schoten prescribing antihypertensive medication to 97,4% of eligible patients and Zoersel 99,5%

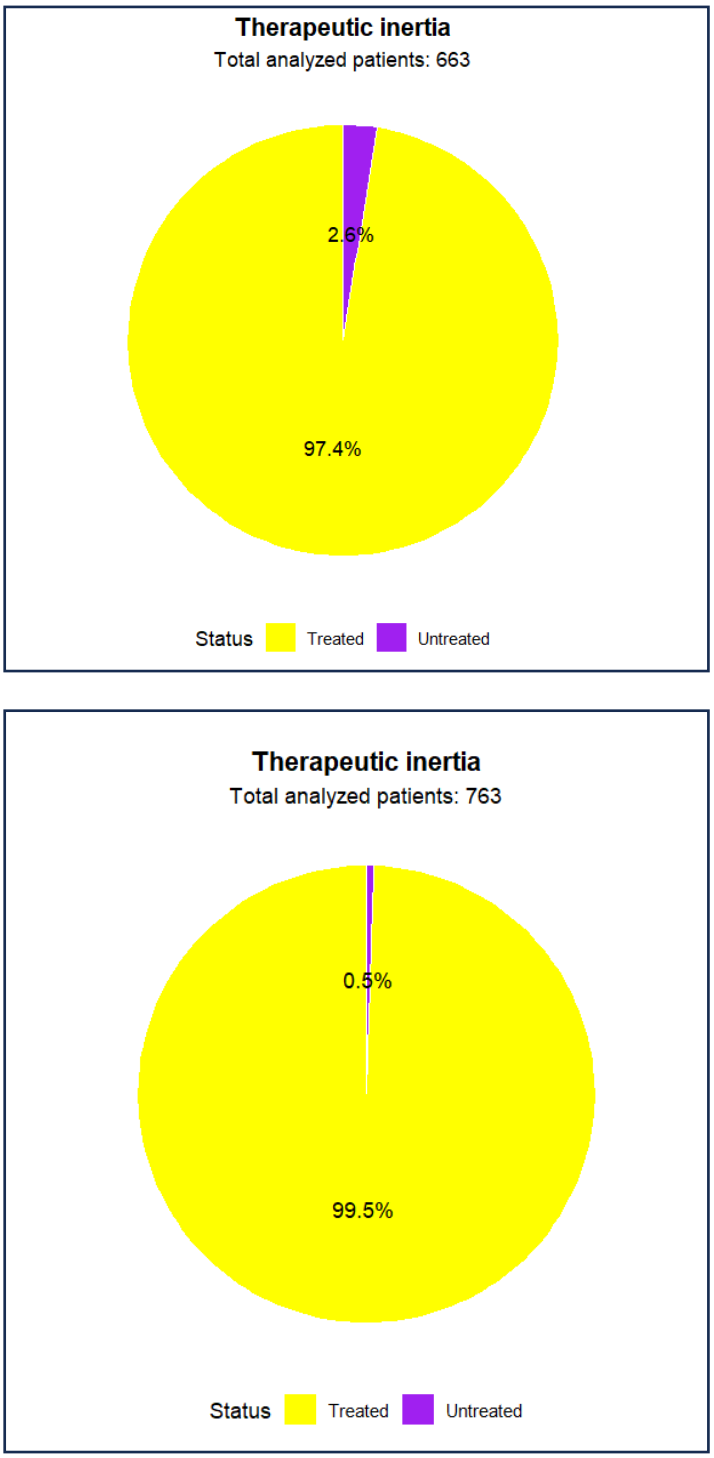


Figure 30: Therapeutic inertia in hypertension population for Schoten (upper) and Zoersel (lower)

Interview results

In the table below (*figure 31*), we depict an overview of the answers given by the 6 GPs interviewed in both practices, organised per theme, and compared to what guidelines recommend. The full interview transcripts can be found in *Appendix 1*.

	Guidelines	Practice
Knowledge of guidelines	ESC/ESH 2018 and EASD 2022 guidelines	Guidelines are known by 4 out of 6 GPs
Staying up to date or other sources for good practice	Not applicable	Medical trainings (4/6 GPs), medical journals (4/6 GPs), pharmaceutic reps (3/6 GPs), own experience (2/6 GPs), local guidelines (Domus Medica, NHG…) (2/6 GPs), learning books (1/6 GPs), American guidelines (1/6 GPs), EBM linker (1/6 GPs)
Challenges in guideline implication	Not applicable	Reimbursement issues, difficulties overcoming own experiences and habits, beliefs about risks and side-effects, experiences with non-motivated patients, cumbersome recommendations not feasible in daily practice.
Diabetes screening population	Adults ≥40y every 3y But high risk groups ealier age and more frequent (yearly)	Routine blood sampling in adults ≥50y every 2y (2/6 GPs) or every year (3/6 GPs), by patient demand (3/6 GPs). Earlier/more often in high risk groups (6/6 GPs) and in patients with aberrant FPG (3/6 GPs)
Diabetes screening manner	2x FPG ≥ 126 mg/dL or HbA1c ≥ 6,5% or OGTT-2h ≥ 200 mg/dL in doubtful cases	2x FPG ≥ 126 mg/dL (5/6 GPs) or HbA1c ≥ 6% (1/6 GPs) or ≥ 9% (1/6 GPs) OGTT only in pregnancy (4/6 GPs), in younger high-risk patients (1/6 GPs) or never (1/6 GPs) with only 1 GP knowing about higher sensitivity
Diabetes work-up	Serum lipids, creatinin, eGFR + Urinanalysis: UACR	Serum lipids, creatinin, eGFR (6/6 GPs) + UACR (guideline knowledge 6/6 GPs but implementation incomplete for all GPs)

		+ liver enzymes (1/6 GPs) + BP (3/6 GPs)
Lifestyle advice in diabetes	Weight loss, exercise, smoking cessation	Weight loss, exercise, diet (6/6 GPs) + blood pressure (2/6 GPs) Smoking cessation mostly mentioned in common CVR management
Pharmacological treatment in diabetes	1st Metformin but recommended early combination therapy	1st Metformin → combination add-on depending on glycemia (5/6 GPs)
	CVR: SGLT2i or GLP1-RA	CVR: SGLT2i (4/6 GPs), no GLP1-RA
	MACE: GLP1-RA	Not mentioned
	HF or CKD: SGLT2i	HF or CKD: SGLT2i (4/6 GPs)
	Overweight: GLP1-RA	Overweight: GLP1-RA (4/6 GPs)
	Low cost; metformin, SU	Add-on to metformin (1/6 GPs)
	Last add-on: insulin injections	Not mentioned
Treatment targets in diabetes	HbA1c ≤ 7% but targets should be individualised	HbA1c ≤ 7% (4/6 GPs) HbA1c ≤ 8 (1/6 GPs) HbA1c ≤ 9% (1/6 GPs) Individualisation by age (6/6 GPs)
Follow-up in diabetes	Regular HbA1c measurements + retinopathy eye exams + neuropathy foot exam + (monofilament testing) + nefropathy (creatinin, eGFR, UACR)	regular HbA1c measurements (6/6 GPs) + retinopathy eye exams annually (5/6 GPs), only when HbA1c is very high or with longstanding diabetes (1/6 GPs) + creatinin/eGFR (6/6 GPs) and UACR mentioned by 5/6 GPs but all confessed forgetting this often + annual monofilament testing mentioned by 3/6 GPs but all GPs reported forgetting this + weight, abdominal circumference and BP (1/6 GPs)

		+ vaccination status (1/6 GPs)
Hypertension screening population/frequency	Every 5y when BP <120/80mmHg Every 3y when BP <130/85mmHg Annual when BP <140/90mmHg → at home measurements	Standard in-office measurement at all visits (5/6 GPs) wit diagnostic target ≥140/90mmHg (5/6 GPs) or SBP ≥160 mmHg (1/6 GPs)
Hypertension screening manner	Office BP measurements +/- at home measurements Gold standard; 24h ambulatory BP measurement	Office BP measurements (6/6 GPs) +/- at home measurements (4/6 GPs +/- 24h ambulatory BP measurement (2/6 GPs)
Hypertension work-up	FPG, serum lipids, blood sodium + potassium + calcium, hemoglobin, TSH, creatinin, eGFR Urinanalysis: UACR 12-lead ECG	FPG, serum lipids, blood sodium + potassium + calcium, hemoglobin, TSH, creatinin, eGFR (4/6 GPs) Urinanalysis: UACR (3/6 GPs) 12-lead ECG never mentioned by any of the GPs
Hypertension lifestyle interventions	Diet, salt restriction, potassium-rich foods, weight loss, exercise, alcohol moderation, smoking cessation, stress management, sleep hygiene, caffeine moderation	Weight management (6/6 GPs), exercise (6/6 GPs), cholesterol lowering (6/6 GPs), sleep hygiene/OSAS screening (6/6 GPs), salt restriction (3/6 GPs), alcohol restriction (1/6 GPs), caffeine restriction (1/6 GPs)
Hypertension medication	1st: ACEi/ARB + CCB/diuretics single-pill combination	1st ACEi or ARB monotherapy (6/6 GPs) OR BB monotherapy (3/6 GPs) in patients with stress or palpitations
	2nd: triple therapy ACEi/ARB + CCB + diuretics	2nd ACEi/ARB + CCB (6/6 GPs)
	3rd: add spironolactone	3rd ACEi/ARB + CBB + diuretic (4/6 GPs)
	CAD/MI/HF: + BB	CAD/MI/HF: + BB (2/6 GPs)
Resistant hypertension	BP uncontrolled despite 3 drugs 1. Assess compliance 2. Exclude secondary cause	BP uncontrolled despite 3 drugs (6/6 GPs) → referral to cardiology (6/6 GPs)

	3. Add spironolactone or BB/alpha-blocker	
Secondary hypertension screening	Young-onset HT, resistant hypertension, hypokalemia, sudden worsening Plasma aldosterone/renin ratio, renal artery imaging, 24h catecholamines	Mostly thaught off in patients with resistant hypertension with only 1 GP reporting anamnestic screening foor symptoms of secondary hypertension causes at diagnosis ➔ Referral to cardiology when suspected (6/6 GPs)
Hypertension complications	Annual: ECG, serum creatinin/eGFR, UACR, ABI Fundoscopy: if BP ≥180/110mmHg Elderly: cognitive screening Very high CVR: carotis doppler	ECG (1/6 GPs), serum creatinin/eGFR (6/6 GPs), UACR (4/6 GPs), ABI (2/6 GPs), carotis doppler (3/6 GPs), no fundoscopy or cognitive screening mentioned

Figure 31: Interview results

Conclusions

This study investigates adherence to T2DM and hypertension guidelines in two Belgian GP practices. For diabetes, both practices showed suboptimal HbA1c testing frequency, falling short of guideline recommendations for regular assessments. BMI reporting also remained low, despite being a key factor in diabetes management. Therapeutic inertia was greater in Schoten, with only 40% of eligible patients receiving antidiabetic medication, compared to 65,1% in Zoersel. In both practices, metformin monotherapy was the most prevalent treatment prescribed, with second-line therapy preferences differing; in Schoten SU were favoured as add-on therapy, whereas Zoersel preferred SGLT2i, the latter aligning more closely to guidelines that prioritize cardio- and nephroprotective agents. Schoten's reliance on SU may reflect a more conservative approach, though guideline updates favour newer agents. The limited use of GLP1-RA in both practices suggests a potential area for improvement, despite underreporting of BMI. Both practices underreported obesity and CKD diagnoses, despite actual high prevalence, which may reflect documentation gaps in the datasets. Schoten performed better annual eGFR testing than Zoersel though neither practice met ideal standards. UACR testing was neglected in both practices.

In hypertension populations, Schoten showed higher BP values than Zoersel, despite more aggressive treatment regimens being used. Medication was initiated in almost all patients with hypertension, showing almost no therapeutic inertia. Schoten favoured combination therapy more than Zoersel, but Zoersel favoured ACEi more often, as according to the guidelines. Schoten had cardiovascular risk scoring in a higher number of patients than Zoersel, but distribution of risks was similar. UACR screening was severely lacking in both practices with <1% of hypertensive patients receiving annual UACR testing, missing a key opportunity for early CKD detection.

Discussion

Study Design

This study examines the adherence to T2DM and hypertension guidelines in first-line medicine, based on two GP practices in Belgium. While guideline adherence is a recognized measure for quality of care, our study suggests that real-world implementation is influenced by multiple barriers, leading to varying prescribing behaviors, gaps in disease monitoring, and opportunities for improvement. Below, we interpret our results based on current evidence, guidelines, recommendations, and clinical challenges.

A study by Milchak et al. **[27]** states that consistent and accurate statements about adherence require several conditions: using multiple data sources (in our case, partly patient records, partly physician interviews), identifying reasons for non-adherence (we did this via physician interviews), linking adherence to patient outcomes (assessed via blood pressure and glycemic control), and most importantly clearly defining adherence. In our study, "adherence" refers to correctly following EASD and ESC/ESH guideline recommendations on screening, risk stratification, treatment and follow-up for T2DM and/or hypertension. Our focus was on physician adherence rather than patient compliance, and while the GP's role in managing chronic, often asymptomatic conditions like T2DM and hypertension is undeniable, evidence **[28]** suggest that patient compliance may play an even larger role in health outcomes, emphasizing personal responsibility in treatment adherence. This is strongly recognized in EASD guidelines, where DSMES programs are pivotal in T2DM management, as well as by Belgian organizations like Diabetes Liga **[12]** and government-led patient education initiatives.

Demographics

The studied patient populations in Schoten and Zoersel were relatively elderly, with average ages around 70 years. Given this older demographic, treatment principles may be less stringent, with greater emphasis on multimorbidity and polypharmacy, potentially complicating outcome interpretation. Concerning sex distribution, women were slightly underrepresented (60% male) in T2DM data, whereas hypertension showed a 50/50 gender distribution. This aligns with EASD reports **[7]** noting women's underdiagnosis due to gendered caregiving roles and insufficient recognition of sex-specific risk factors [**29].** For hypertension, mixed evidence exists on sex-based diagnostic gaps, with some studies reporting underdiagnosis in women **[30]** and others in men **[31]**, though our data revealed male predominance in younger cohorts (<40 years) in Zoersel.

Screening and diagnostic gaps

We included patients in our study based on existing diagnoses, so we collected no quantitative data on screening rates from medical records. Conclusions about screening in this paper are thus made based on data from interviews. We can state however, that the diagnosis coding of patients fulfilling diagnotisc criteria was low in both practices. GPs unanimously reported annual blood tests and regular BP measurements for patients ≥50 but only some used risk profiles to guide screening at an earlier age. This approach may miss opportunities in already underrepresented young populations **[7].** Moreover, this screening method assumes regular GP visits, requiring patient initiative. We found no studies clearly demonstrating the benefit of physician-initiated versus patient-initiated screening, as better-educated, motivated patients mainly may respond to invitations but would likely seek care independently, while still missing opportunities in socioeconomically vulnerable groups, who are less likely to respond to screening invitations **[32]** .

Risk Stratification: Documentation Deficits

We collected extensive data on risk stratification for both conditions. Despite universal LDL monitoring, key parameters like BMI and total CVR were underreported, even when automated tools (e.g., CareConnect's CVR and BMI calculators) were available. Since lab result parameters such as LDL and eGFR were not underreported, the most logical explanation for underreporting other risk factors is the need for manual data entry in medical files, while lab results are automatically extracted. These documentation gaps risk underestimating disease severity and delaying intensification of therapy.

Other parameters were clearly undermeasured, besides from documentation lacking. For instance, UACR—a cornerstone of early CKD detection as described in guidelines since 2013 (hypertension) and 2019 (diabetes)—was rarely measured, even it is not subject to documentation bias.

Therapeutic Inertia

We found greater therapeutic inertia for T2DM in Schoten than in Zoersel, whereas hypertension management showed minimal inertia in both practices. The inter-practice differences in diabetes may stem from variations in physician motivational/prescribing techniques or patient. Interviews suggested better EASD guideline knowledge in Zoersel and higher ASCVD prevalence (or reporting), prompting earlier treatment escalation because of higher total risk estimations.

Condition-specific inertia was also evident with inertia being higher for T2DM than hypertension, likely reflecting differences in guideline clarity, heterogenity in diabetes management and underestimation of treatment urgency. Hypertension guidelines (ESC/ESH) are clearly structured and regularly updated, whereas EASD relies on fragmented consensus reports with ADA. Additionally, complex treatment algorithms and reimbursement barriers in (e.g., restrictive criteria for SGLT2i/GLP1-RA; *see Appendices A-F)* influence treatment choices in T2DM. In contrast, hypertension management benefited from simpler escalation protocols. Notably, all patients with incomplete BP records were excluded, leaving in diagnostic inertia for T2DM data, but removing it for hypertension (again, FPG and HbA1c did not undergo documentation deficits because it is automatically integrated in the data, while hypertension has to be manually inputted).

Disease Management

Type 2 Diabetes Management

Metformin monotherapy was the preferred first-line treatment in both practices. Second-line choices varied: Zoersel used newer agents like SGLT2i more appropriately, but both practices underused nephro-/cardioprotective drugs (SGLT2i, GLP1-RAs), despite comorbid ASCVD/CKD in many patients. These findings align with a study by Raat et al. **[33],** which also noted SGLT2i/GLP1-RA underuse, attributing this to delayed reimbursement (*Appendices A-F*), restrictive initial indications, lack of GP awareness about guideline updates, and prescribing/data entry challenges. Interviews revealed reimbursement criteria as the primary barrier. Additionally, since these agents are newer, GPs relying on experiential knowledge may be slower to adopt them. For GLP1-RAs, underreported obesity (a key indication) and BMI measures may also play a role, as well as hesitance in patients to start injections. Reimbursement restrictions (see *Appendices A-F)* and supply shortages (due to demand for weight loss purposes **[34]**) probably further limit their use. The recent introduction of GIP/GLP1-RAs and their high out-of-pocket cost highlight patient demand. Insulin therapy was correctly seen as last-choice add-on, and was often done in consultation with an endocrinologist.

Hypertension Management

In the management of hypertension, it is important to note the need to treat cardiovascular risk, rather than BP values alone. Our initial audit included patients with SBP ≥140 or DBP ≥90 mmHg, but guidelines also define "elevated BP" (120–139/70–89 mmHg), where high-risk patients may benefit from treatment despite not meeting diagnostic thresholds. The underreporting of CVR itself or factors contributing to total risk, could thus have been of influence in therapy decision-making. RAAS blockers were commonly used as first choice in monotherapy when renal function allowed the use of these agents; in high grade CKD the use of CCB in monotherapy was often reported. CCB were also seen as the first add-on step to RAAS blockers when BP remained uncontrolled. Zoersel used more ACEis, which are guideline-recommended for organ protection, but BP control was worse there, possibly due to undertitration or patient compliance issues. Most GPs preferred monotherapy initiation (vs. guideline-recommended bitherapy) to mitigate side effects, reserving combination therapy for uncontrolled cases or in cases with very high BP. Beta-blockers were sometimes used for hypertensive patients suffering from stress and anxiety, diverging from evidence-based indications **[35].**

Disease Follow-up

For diabetes, regular HbA1c testing (every 2–6 months depending on glycemic control) is crucial. Both practices exceeded 6-month intervals, even for high-risk patients, consistent with Khunti et al.'s reported 30–60% inertia. BGM was mostly used in patients on insulin regimens, and most GPs did not use CGM techniques.

Regular follow-up of UACR and eGFR is important for both pathologies discussed. While renal function (eGFR) was tracked well via annual blood tests, UACR testing was grossly lacking, despite measurements being recommended in the guidelines since 2013 for hypertension and 2019 for type 2 diabetes. Possible explanations for undertesting are knowledge gaps, time constraints, and fragmented care. Notably, eGFR testing alone is insufficient for early CKD detection.

Usefulness of ECGs in T2DM and hypertension management was seen as low by the GPs interviewed because of issues in time management and interpretion limitations. Most GPs were rather inclined to refer to cardiology when suspecting cardiovascular disease or the need for an ECG. Monofilament testing was generally recognized to be important in T2DM management, but often forgotten due to time constraints and the lack of ‘check-lists’ reminding them of everything that needs to be done in the management of specific chronic conditions. Fundoscopy by referral to ophtalmology was done by almost all GPs in the follow-up of T2DM, especially when being a part of the care path a specific patient is involved in. Fundoscopy at diagnosis of T2DM was solely performed when glycemic parameters were very high or with symptomatic presentation. Fundoscopy in high-grade hypertensive patients was not reported, possibly because of local guidelines not recommending this practice. Performing of ABI, carotic doppler and cognitive testing was poorly done, with the use of carotic auscultation being reported more often. For the referral to diabetes educators, most GPs reported most patients to be hesitant.

Poor disease monitoring can lead to undertreatment and occurrence of preventable complications. In both practices, there was significant room for improvement in the correct follow-up of diabetes and hypertension. Possible solutions for these shortcomings could include scheduling the next consult during previous consultations, sending patient reminders, or improving patient education thereby increasing self-efficacy [**36**].

Conclusion and Future Directions

As knowledge in medicine keeps rapidly expanding, the need for readily available, actionable, clear overviews of medical research becomes increasingly essential. Summarised evidence-based recommendations can be found in clinical guidelines that are readily available and constantly assessed (e.g., GRADE system **[26]**). Nevertheless, a significant gap remains between guidelines and their real-world application in clinical practice. According to the findings in this study, guideline adherence gaps for hypertension and T2DM included:

1. Awareness amongst GPs: the majority of interviewed GPs claimed to know the recommendations of the ESC/ESH and EASD guidelines, but not always being up to date with the newest evolutions, relying instead on clinical experience, pharmaceutical reps, training in small groups, prescriptions on medical journals or different (outdated) local guidelines such as Domus Medica guidelines [**37**]**,** despite knowledge of the outdatedness and infrequent updates of these recommendations.
2. Screening: all GPs were aware of proper screening tests and intervals and most reported proper screening in their practice. However, the average reported starting age of 50 years exceeded recommendations and screening intervals extracted from medical records were inproper. This shows overestimation of adherence when measured through self-reporting.
3. Diagnosis: all GPs knew T2DM diagnostic thresholds, but the reported hypertension diagnostic thresholds varied. All GPs reported adjusting thresholds to patient profiles, with some being stricter than others. Despite good knowledge, terapeutic inertia was higher for diabetes, possibly due to underestimation of early intervention benefits. All GPs reported using at-home BP measurements in some cases to confirm hypertension diagnosis, with Schoten also reporting 24h measurements, a practice not performed in Zoersel. While HbA1c and FPG testing were widely used, almost no OGTTs were done in neither practice. All GPs reported initiating the foreseen care paths for diabetes type 2 upon diagnosis.
4. Risk stratification: in the interviews, GPs reported assessing for lifestyle factors upon diagnosis and through follow-up and most frequent interventions in this area were said to be weight management, sugar ingestion restrictions and smoking cessation. However, from patient record data, we found BMI and CVR documentation to be poor. This coud be because of an overestimation of lifestyle assessment by GPs, either because of difficulties documenting in patient records. All GPs mentioned performing yearly blood draws for eGFR, creatinin and lipid profile, with patient record data confirming this. Proper registration of these measures could be because of automated extraction out of lab results with no need of manually entering them in the records. A true underuse of UACR was seen in the records, despite being a lab parameter, with interviews acknowledging this fact. Different opinions about monofilament testing, ECG and fundoscopy were reported in interviews with numbers being generally too low.
5. Therapeutic inertia: underuse of newer nephro- and cardioprotective agents was seen in T2DM and hesitation to commence bitherapy instead of monotherapy was observed in hypertension. Reasons reported in interviews are administrative thresholds, fear for hypotension or side effects.
6. Follow-up: some testings such as eGFR and LDL were performed correctly, with measurements needing manual entering in patient records to be vastly underreported. Huge room for improvement was found to be in UACR measuring, monofilament testing, BMI reporting, CVR calculations, ECGs, monofilament testing and timely determination of glycemic measures.

Despite their value, implementing guidelines into practice can be difficult, and adherence levels remain low in many settings. Evidence shows that adherence to treatment guidelines leads to lower mortality and hospital admission rates, better disease control and enhanced monitoring of complications **[38,**

39] but can fall short on multiple levels: clinician adherence, patient adherence, practical limitations and structural implementations **[40]**. Some of the barriers for guideline implementation by clinicians cited in literature are:

- Lack of awareness and accessibility: physicians can't apply guidelines they don't know about. Timely and clear dissemination through accessible formats is thus crucial .
- Clinician-specific challenges: clinicians may delay initiating or adjusting treatments due to uncertainties, role confusion, or patient preferences **[40]**.
- Disagreement and practical constraints: GPs sometimes disagree with recommendations due to skepticism about evidence quality or find guidelines too impractical to implement in everyday clinical settings. Time constraints, unclear instructions, and misalignment with patient values or local resources further reduce adherence **[41].**
- Volume and complexity: the sheer number of available guidelines and their detail can overwhelm practitioners, making it difficult to apply them effectively in real time **[41].**

Beyond clinician's behaviour, patient adherence also plays a critical role. A report from the World Health Organization (WHO) highlights several problems influencing patient adherence **[42]**.

- Patient's understanding of the treatment: comprehension of the purpose and importance of treatment influences compliance.
- Quality of the relationship between patient and healthcare provider: patients trusting their clinician tend to have better compliance rates.
- Socioeconomic factors: financial barriers and healthcare access influence whether patients can follow prescribed regimens.
- Treatment complexity: complex regimens tend to have lower compliance.
- Individual beliefs and motivation: perceptions of treatment efficacy and concerns about side effects shape adherence behaviours.

Systematic reviews found wide variations in adherence rates in T2DM **[38**] and hypertension **[27, 43]**, depending on which measure of adherence is used. In a study by **[27]**,assessing adherence in patients with hypertension, the use of different adherence evaluation methods (prescription data, survey data, medical records…), the overlooking of patient comorbidities and the diverse definition of 'adherence' are set forward as reasons why adherence rates may vary across studies. The study emphasizes the importance of using a combination of data sources and methods to measure adherence, defining clear criteria of the meaning of 'adherence', linking adherence measures to patient outcomes and considering explicit and implicit reasons for non-adherence **[27]**.

Interventions to Improve Adherence

In general, informing physicians does not seem to be a major issue, primarily through continuing medical education (CME). In Belgium, doctors must earn a certain number of accreditation points each year to maintain their medical license, which encourages participation. However, the implementation of guidelines does not always align with GPs knowledge, and our research identifies this as the most significant gap.

The main barriers to guideline adherence reported by the interviewed physicians include:

- Reimbursement issues (e.g., appendices)
- Preference for personal knowledge/experience over new guidelines
- Negative patient experiences with certain policies

These findings largely align with a study by Banach et al. **[8**]. Additionally, time constraints, entrenched workflows, and habitual practices among GPs further hinder adherence.

Concerning patient adherence, the EASD guidelines and a study by [**42**] highlight several obstacles:

- Negative experiences with medication or skepticism about treatment efficacy/side effects
- Poor access to medication
- Complex medication regimens
- Multimorbidity, aging-related memory decline, and disability
- Poor quality of life
- Low disease awareness (particularly in asymptomatic conditions)
- Belief in alternative medicine

On the other hand, factors that improve treatment adherence include:

- Rapid achievement of therapeutic targets without side effects
- Scheduling follow-up appointments for further testing or prescription renewals

This highlights the importance of individualized care and a holistic approach is evident, a point emphasized in both ESC/ESH and EASD reports (e.g., lifestyle interventions, education). Implementing such strategies often requires personalized approaches that cannot be reduced to generic advice.

To improve adherence, possible interventions include:

- Education and communication improving guideline understanding among clinicians and patients. Patient education aims to share responsibility, encouraging joint decision-making in follow-ups, testing, and therapy choices.
- Process simplifying reducing complexity and providing practical steps for implementation in real-world practice. An example of this could be integrating structured protocols into electronic health records (e.g., checklists with automated alerts for physicians and, privacy-permitting, patients).
- Regular practice audits to identify gaps in disease management, reporting, and coding.
- Government-led care pathways, which interviews suggest work well for diabetes management. We propose exploring state-organized invitations for routine blood screenings at a certain age (similar to Belgium's mammography and iFOBT programs).
- Enhanced adherence monitoring systems, possibly involving nursing staff (e.g., 'VIHP'—nurses in general practice), as GPs often lack time for this.

A study by **[44**] assessed GPs' preferences for improving guideline adherence. The top choices were small-group educational meetings (such as CME) and feedback through audits. CME sessions were cited by GPs in our study as their primary source of guideline updates. Notably, large-group meetings scored poorly, emphasizing the need for interactive, small-group formats. We hope our study results can assist both included practices in regard to feedback. Other high-ranking interventions included organizational changes (e.g., improving interdisciplinary collaboration) and involvement of local authorities in relevant health topics

These changes could reduce variability in care, improve outcomes, and align practices with international standards. They underscore the need for sustained commitment from policymakers, physicians, and healthcare professionals to ensure diabetes and hypertension care adheres to the latest guidelines. The problem of non-adherence is not just an issue of individual choices by clinicians, but reflects broader challenges for healthcare systems. Addressing non-adherence can lead to improved patient outcomes and more efficient use of resources, but requires constant commitment.

Implications of 2024 ESC/ESH Updates

Recent guideline changes underscore the need for continuous GP education. Below, we will summarize the key changes in the 2024 update of ESC guidelines as compared to 2018.

- Blood pressure classification: in the 2018 guidelines, BP was categorized as optimal, normal, high-normal, grade 1, 2, and 3 hypertension. In the update these categories are simplified to non-elevated, elevated, and hypertension.
- Cardiovascular risk assessment: introduction of SCORE2 model for individuals aged 40 to 69 years old and SCORE2-OP for those 70+, as replacing models for SCORE.
- Diagnostic thresholds & home monitoring: greater emphasis on at home blood pressure measurements rather than relying solely on in-office confirmatory readings.
- Echocardiography indications: now recommended not only for ECG abnormalities but also if symptoms of cardiac disease are present or when results could influence antihypertensive treatment decisions.
- Vascular ultrasound: carotid/femoral artery ultrasound should be considered for plaque detection in patients where findings may alter management—not just in those with known vascular disease. Notably, femoral artery assessment is newly included.
- Preferred mineralocorticoid receptor antagonist (MRA): eplerenone is now favored over spironolactone due to its better safety profile (fewer side effects).
- Treatment targets & individualization: age-based relaxation of targets now starts at ≥85 years (previously ≥65). Additional considerations for adjusting targets should be frailty at any age, orthostatic symptoms and reduced life expectancy.
- Lowered treatment initiation thresholds: antihypertensive therapy is now recommended at lower thresholds for pregnant women, diabetics and CKD patients
- SGLT2 inhibitors are now included as a treatment option for heart failure patients.

Variability in care stems from patient-, physician-, and system-level factors. Holistic, individualized approaches—emphasized by both EASD and ESC/ESH—are essential and multidisciplinary collaboration, EHR optimization, and policy reforms can bridge guideline-practice gaps. Systemic improvements are needed to align care with evolving evidence. Prioritizing workflow optimization, reimbursement reforms, and multidisciplinary collaboration will be essential to reduce variability and improve outcomes in T2DM and hypertension management.

Strengths and limitations of this study

Strengths:

- The use of real-world clinical data enhances the applicability of findings to everyday primary care settings, reflecting real-world patient management rather than idealised trial conditions and identifying actionable barriers.
- Focus on primary care; given the central role of GPs in managing hypertension and diabetes, this study provides relevant insights for frontline clinical decision-making.
- Mixed methods: the use of patient record data combined with GP interviews provides an objective as well as a subjective measure of guideline adherence.
- Local quality improvement potential; as the study was conducted in two GP practices, the findings directly inform targeted improvement interventions in these settings

Limitations

- Retrospective design: as an observational study using existing records, causality cannot be inferred, and unmeasured confounders may influence results.

- Incomplete data: key variables were often missing, limiting the scope of analysis.
- Documentation bias: comorbidities and complications may be underreported in GP records, particularly if asymptomatic or managed in secondary care.
- Lack of sociodemographic data: absence of socioeconomic status, ethnicity, or health literacy data prevents exploration of disparities in care.
- Heterogeneous EHR documentation: variability in coding practices (e.g., diagnostic criteria, free text vs. structured entries) between practices may affect data consistency.
- Single-country setting: findings may not generalize to healthcare systems with different structures or reimbursement policies.

References

1. V A. Hoge bloeddruk - Ligue Cardiologique Belge [Internet]. Ligue Cardiologique Belge. 2012. Available from: https://liguecardioliga.be/hoge-bloeddruk/

2. Diabetescijfers alarmerend: stijging zet zich door | Diabetes Liga [Internet]. Diabetes Liga. 2024. Available from: https://www.diabetes.be/nl/nieuws/diabetescijfers-alarmerend-stijging-zet-zich-door

3. Malik R, Georgakis MK, Vujkovic M, Damrauer SM, Elliott P, Karhunen V, et al. Relationship Between Blood Pressure and Incident Cardiovascular Disease: Linear and Nonlinear Mendelian Randomization Analyses. Hypertension [Internet]. 2021 Jun;77(6):2004–13. Available from: https://www.ahajournals.org/doi/10.1161/HYPERTENSIONAHA.120.16534

4. Laakso M. Hyperglycemia and cardiovascular disease in type 2 diabetes. Diabetes. 1999 May 1;48(5):937–42.

5. Hao Z, Li G, Sun Y, Liu Y. Relationship and associated mechanisms between ambulatory blood pressure and clinic blood pressure with prevalent cardiovascular disease in diabetic hypertensive patients. Medicine. 2017 Apr;96(16):e6756.

6. Davies MJ, Aroda VR, Collins BS, Gabbay RA, Green J, Maruthur NM, et al. Management of hyperglycaemia in type 2 diabetes, 2022. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). Diabetologia [Internet]. 2022 Sep 24;65(12). Available from: https://link.springer.com/article/10.1007/s00125-022-05787-2

7. 2018 ESC/ESH Guidelines for the management of arterial hypertension. Journal of Hypertension. 2019 Jan;37(1):226.

8. Banach M, Gaiţă D, HaluzíkM, Andrej Janež, Zdravko Kamenov, Kempler P, et al. Adoption of the ADA/EASD guidelines in 10 Eastern and Southern European countries: Physician survey and good clinical practice recommendations from an international expert panel. Diabetes Research and Clinical Practice. 2021 Feb 1;172:108535–5.

9. Stone MA, Charpentier G, Doggen K, Kuss O, Lindblad U, Kellner C, et al. Quality of Care of People With Type 2 Diabetes in Eight European Countries. Diabetes Care [Internet]. 2013 Apr 29 [cited 2020 Feb 20];36(9):2628–38. Available from: https://care.diabetesjournals.org/content/diacare/36/9/2628.full.pdf

10. Kollias A, Foukarakis E, Karakousis K, Stergiou GS. Implementation of the 2018 ESC/ESH Guidelines for the management of hypertension in primary care: the HYPEDIA study. Journal of Human Hypertension [Internet]. 2022 Jul 14 [cited 2022 Nov 8];1–6. Available from: https://www.nature.com/articles/s41371-022-00713-w

11. Risico op diabetes | Domus Medica [Internet]. Domusmedica.be. 2023 [cited 2025 Apr 15]. Available from: https://www.domusmedica.be/expertisedomein/preventie-gezondheidspromotie/gezondheidsgids-domus-medica/onderwerpen/risico-op-diabetes

12. Diabetes: zorgsystemen en voorzieningen | Diabetes Liga [Internet]. Diabetes Liga. 2025. Available from: https://www.diabetes.be/nl/zorgsystemen

13. Bewegen Op Verwijzing [Internet]. www.vlaanderen.be. Available from: https://www.vlaanderen.be/bewegen-op-verwijzing

14. Vlaanderen.be. 2025 [cited 2025 Apr 15]. Available from: https://www.vlaanderen.be/stoppen-met-roken

15. TABAKSTOP [Internet]. Tabakstop.be. 2025 [cited 2025 Apr 15]. Available from: https://tabakstop.be/

16. Lingvay I, Sumithran P, Cohen RV, le Roux CW. Obesity management as a primary treatment goal for type 2 diabetes: time to reframe the conversation. The Lancet [Internet]. 2021 Sep 30;399(10322). Available from: https://www.sciencedirect.com/science/article/pii/S014067362101919X#bib11

17. Wing RR. Does Lifestyle Intervention Improve Health of Adults with Overweight/Obesity and Type 2 Diabetes: Findings from the Look AHEAD Randomized Trial. Obesity. 2021 May 14;29(8).

18. Neuen BL, Young T, Heerspink HJL, Neal B, Perkovic V, Billot L, et al. SGLT2 inhibitors for the prevention of kidney failure in patients with type 2 diabetes: a systematic review and meta-analysis. The Lancet Diabetes & Endocrinology. 2019 Sep;7(11).

19. Palmer SC, Tendal B, Mustafa RA, Vandvik PO, Li S, Hao Q, et al. Sodium-glucose cotransporter protein-2 (SGLT-2) inhibitors and glucagon-like peptide-1 (GLP-1) receptor agonists for type 2 diabetes: systematic review and network meta-analysis of randomised controlled trials. BMJ [Internet]. 2021 Jan 13 [cited 2021 Mar 15];372. Available from: https://www.bmj.com/content/372/bmj.m4573

20. Sibal L, Home PD. Management of type 2 diabetes: NICE guidelines. Clinical Medicine [Internet]. 2009 Aug 1 [cited 2019 Mar 29];9(4):353–7. Available from: http://www.clinmed.rcpjournal.org/content/9/4/353

21. Brown RE, Welsh P, Logue J. Systematic review of clinical guidelines for lipid lowering in the secondary prevention of cardiovascular disease events. Open Heart [Internet]. 2020 Dec 1 [cited 2021 Dec 7];7(2):e001396. Available from: https://openheart.bmj.com/content/7/2/e001396.info

22. Escobar Arregoces FM. The Relationship Between Diabetes Mellitus Type 2 and Periodontal Disease. Current Research in Diabetes & Obesity Journal. 2019 Mar 22;10(2).

23. O'Neil N, Hoyt K. Implementing an EMR Change for the Diabetic Foot Assessment. Doctor of Nursing Practice Final Manuscripts [Internet]. 2017 May 27 [cited 2024 Apr 18]; Available from: https://digital.sandiego.edu/dnp/52/

24. John William McEvoy, McCarthy CP, Rosa Maria Bruno, Brouwers S, Canavan MD, Ceconi C, et al. 2024 ESC Guidelines for the management of elevated blood pressure and hypertension. European Heart Journal [Internet]. 2024 Aug 30;45(38). Available from: https://academic.oup.com/eurheartj/article/45/38/3912/7741010?login=false

25. Crea F. The new SCORE2 risk prediction algorithms and the growing challenge of risk factors not captured by traditional risk scores. European Heart Journal. 2021 Jul 1;42(25):2403–7.

26. Baron DM, Metnitz PGH, Rhodes A, Kozek-Langenecker SA. Clinical guidelines: How can we improve adherence and implementation? European Journal of Anaesthesiology | EJA [Internet]. 2017 Jun 1;34(6):329–31. Available from: https://journals.lww.com/ejanaesthesiology/fulltext/2017/06000/clinical_guidelines__how_can_we_improve_adherence.2.aspx

27. Milchak JL, Carter BL, James PA, Ardery G. Measuring Adherence to Practice Guidelines for the Management of Hypertension. Hypertension [Internet]. 2004 Nov [cited 2019 Jun 25];44(5):602–8. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1414061/

28. Sofia Axia Karlsson, Eliasson B, Franzén S, Mervete Miftaraj, Svensson J, Karolina Andersson Sundell. Risk of cardiovascular event and mortality in relation to refill and guideline adherence to lipid-lowering medications among patients with type 2 diabetes mellitus in Sweden. BMJ open diabetes research & care. 2019 Apr 1;7(1):e000639–9.

29. Brown M, Bobroff L, O'Neal LJ. Women and Diabetes. EDIS. 2008 Feb 2;2008(2).

30. Antonetti I, Bisognano JD. Hypertension in Women. Management of Cardiovascular Disease in Women. 2013 Dec 20;251–63.

31. An J, Novelli A, Huang X, Fischer H, Reynolds K, Ni L, et al. Abstract 4136846: Sex Differences in Hypertension Diagnosis among Young Adults. Circulation. 2024 Nov 12;150(Suppl_1).

32. Pill R, French J, Harding K, Stott N. Invitation to attend a health check in a general practice setting: comparison of attenders and non-attenders. The Journal of the Royal College of General Practitioners [Internet]. 1988 Feb;38(307):53–6. Available from: https://www.ncbi.nlm.nih.gov/pubmed/3204565

33. Raat W, Mamouris P, Mathieu C, Goderis G, Vaes B. Trends in type 2 diabetes medication use and guideline adherence in Belgian primary care (2019–2023). Primary Care Diabetes. 2025 Feb;19(1):29–34.

34. Saiyed AA, Darr MQ, Ghulam SS. A review on the impact of the worldwide shortage of glucagon-like peptide-1 medications on control of diabetic patients. International Journal Of Community Medicine And Public Health. 2024 Oct 7;11(11):4523–9.

35. Wu SC, Oltrona L, Secchi MB, Mancarella S, Bettazzi L, Civelli M, et al. Comparison of the efficacy of monotherapy with a beta-blocker, a diuretic, and ACE inhibitors in the control of blood pressure during stress. Minerva cardioangiologica [Internet]. 1989;37(7-8):323–31. Available from: https://www.ncbi.nlm.nih.gov/pubmed/2558329

36. Khunti K, Gomes MB, Pocock S, Shestakova MV, Pintat S, Fenici P, et al. Therapeutic inertia in the treatment of hyperglycaemia in patients with type 2 diabetes: A systematic review. Diabetes, Obesity and Metabolism. 2017 Oct;20(2):427–37.

37. Hypertensie | Domus Medica [Internet]. Domusmedica.be. 2009 [cited 2025 Apr 24]. Available from: https://www.domusmedica.be/richtlijnen/hypertensie **37**

38. Vianini E, Pandey A, Rolland C, Nomxolisi Ngubane, Mueller-Wieland D, Gilbert J, et al. Systematic Literature Review of the Impact of Type 2 Diabetes and Heart Failure Guideline Adherence on Clinical and Economic Outcomes. Diabetes Therapy. 2025 Mar 27;

39. Gabler M, Picker N, Geier S, Ley L, Aberle J, Lehrke M, et al. Guideline Adherence and Associated Outcomes in the Treatment of Type 2 Diabetes Mellitus Patients With an Incident Cardiovascular Comorbidity: An Analysis Based on a Large German Claims Dataset. Diabetes Therapy [Internet]. 2021 Apr 1 [cited 2022 Nov 29];12(4):1209–26. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7994459/#:~:text=Most%20patients%20with%20type%202%20diabetes%20%28T2DM%29%20suffer

40. Lu Y, Oreoluwa Arowojolu, Qiu X, Liu Y, Curry LA, Krumholz HM. Barriers to Optimal Clinician Guideline Adherence in Management of Markedly Elevated Blood Pressure. JAMA Network Open [Internet]. 2024 Aug 6 [cited 2025 Jan 6];7(8):e2426135–5. Available from: https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2822026

41. Heneghan C, Perera R, Mant D, Glasziou P. Hypertension guideline recommendations in general practice: awareness, agreement, adoption, and adherence. British Journal of General Practice. 2007 Dec 1;57(545):948–52.

42. Burnier M, Egan BM. Adherence in Hypertension. Circulation Research [Internet]. 2020 Mar 29;124(7):1124–40. Available from: https://www.ahajournals.org/doi/10.1161/CIRCRESAHA.118.313220

43. Uchmanowicz B, Jankowska EA, Uchmanowicz I, Morisky DE. Self-Reported Medication Adherence Measured With Morisky Medication Adherence Scales and Its Determinants in Hypertensive Patients Aged ≥60 Years: A Systematic Review and Meta-Analysis. Frontiers in Pharmacology. 2019 Mar 1;10.

44. Lugtenberg M, Burgers JS, Han D, Westert GP. General practitioners' preferences for interventions to improve guideline adherence. Journal of Evaluation in Clinical Practice. 2014 Jun 21;20(6):820–6.

Appendix A: reimbursement criteria for dulaglutide

1. The specialty can be reimbursed when used for the treatment of patients enrolled in a diabetes care pathway (‘zorgtraject’ or ‘conventie’).
2. The specialty drug (liraglutide) will be reimbursed if administered to a patient meeting all the following conditions:

- Type 2 diabetes with insufficient glycemic control (HbA1c > 7.5%) after at least 3 months of treatment with one or more antidiabetic agents, including metformin.
- Body Mass Index (BMI) ≥ 30 kg/m² at the time of the first application.
- The treatment **must never be used as monotherapy but always in combination with:
    - Metformin alone
    - Metformin + a sulfonylurea
    - Metformin + a glinide
    - Metformin + a glitazone
    - Metformin + basal insulin

Initial Application:

- Reimbursement is granted for a maximum of 13 packs (each containing 4 pre-filled syringes) per 12-month period
- The treating physician must complete and sign the application form.
- The advising physician issues an initial authorization certificate, valid for a maximum of 12 months.

Renewal Application: reimbursement can be extended for an additional 12-month period. The physician must submit a completed and signed renewal form confirming glycemic control after the first 12 months of treatment: the patient achieved HbA1c < 7.0% or a reduction of ≥ 1.0% from baseline For subsequent renewals, the physician must confirm adequate glycemic control.

Appendix B: reimbursement criteria for liraglutide

1. The specialty can be reimbursed when used for the treatment of patients enrolled in a diabetes care pathway (‘zorgtraject’ or ‘conventie’).
2. The specialty drug (liraglutide) will be reimbursed if administered to a patient meeting all the following conditions:

- Type 2 diabetes with insufficient glycemic control (HbA1c > 7.5%) after at least 3 months of treatment with one or more antidiabetic agents, including metformin.
- Body Mass Index (BMI) ≥ 30 kg/m² at the time of the first application.
- The treatment **must never be used as monotherapy but always in combination with:
    - Metformin alone
    - Metformin + a sulfonylurea
    - Metformin + a glinide
    - Metformin + a glitazone
    - Metformin + basal insulin

Initial Application:

- Reimbursement is granted for a maximum of 6 packs (each containing 2 pre-filled syringes) for an initial 6-month period, corresponding to a dosage of 1.2 mg per day. .
- The treating physician must complete and sign the application form.
- The advising physician issues an initial authorization certificate, valid for a maximum of 6 months.

Renewal Application: reimbursement can be extended for an additional 12-month period, subject to:

- Option 1:12 packs of 2 pre-filled syringes(1.2 mg/day).
- Option 2:18 packs of 2 pre-filled syringes (1.8 mg/day).

Conditions for renewal: the physician must submit a completed and signed renewal form confirming:

- Either:after the first 6 months, the patient achieved HbA1c < 7.0% or a reduction of ≥ 1.0% from baseline (measured at the start of liraglutide 1.2 mg/day). For subsequent renewals, the physician must confirm adequate glycemic control.

OR

- If glycemic control remains insufficient (HbA1c > 7.5% or reduction < 1.0%) after 6 months at 1.2 mg/day, the dose is increased to 1.8 mg/day Subsequent renewals require confirmation of adequate glycemic control.

Appendix C: reimbursement criteria for semaglutide

1. The specialty can be reimbursed when used for the treatment of patients enrolled in a diabetes care pathway (‘zorgtraject’).
2. The pharmaceutical specialty based on semaglutide is reimbursedif it is administered when the beneficiary meets all the following criteria:

- Type 2 diabetes that, at the time of the initial request, is insufficiently controlled (HbA1c > 7.5%) after at least 3 months of treatment with one or more antidiabetic drugs, including metformin.
- At the time of the initial request, has an elevated body mass index of ≥ 30 kg/m².
- The treatment with the specialty is never in monotherapy but in combination with:
    - metformin
    - metformin and a hypoglycemic sulfonamide
    - metformin and a glinide
    - metformin and a glitazone
    - metformin and basal insulin.

Initial Application:

- Reimbursement is granted for a maximum of 13 packages (each containing 1 pre-filled syringe) for an initial 12-month period
- The treating physician must complete and sign the application form.
- The advising physician issues an initial authorization certificate, valid for a maximum of 12 months.

Request for renewal: reimbursement can be extended for an additional 12-month period. The physician must submit a completed and signed renewal form confirming glycemic control after the first 12 months of treatment: the patient achieved HbA1c < 7.0% or a reduction of ≥ 1.0% from baseline For subsequent renewals, the physician must confirm adequate glycemic control.

Appendix D: reimbursement criteria for canaglifozin

1. The specialty can be reimbursed when used for the treatment of patients enrolled in a diabetes care pathway ('zorgtraject').
2. The pharmaceutical specialty (canagliflozin) qualifies for reimbursement when administered to beneficiaries who meet all the following criteria:

- Age > 18 years.
- Glomerular filtration rate (GFR) ≥ 60 mL/min/1.73 m².
- Type 2 diabetes with insufficient glycemic control (HbA1c ≥ 7.0% and ≤ 9.0%) despite hygienic-dietary measures.
- Prior treatment for at least 3 months with at least one antidiabetic agent (including metformin).

Additional Requirements: must be used in combination with at least one other antidiabetic, excluding:

- Incretin mimetics (GLP-1 analogs) for the entire treatment duration.
- Other SGLT2 inhibitors
- Gliptins (DPP-4 inhibitors) added during treatment.

Reimbursement Quantity & Authorization:

- Maximum dosage:1 tablet per day
- Initial approval (300 days): 1 pack of 30 tablets (100 mg) + 3 packs of 90 tablets (100 mg).
    - dose escalation (after ≥6 months at 100 mg if insufficient response): 1 pack of 30 tablets (300 mg) + 3 packs of 90 tablets (300 mg) for a second 300-day period.
- Based on a completed and signed application form by the treating physician.
- The advising physician issues an authorization certificate

Renewal (max 360 days per extension): requires HbA1c ≤ 7.5% or ≥ 0.5% reduction from baseline after 12 months.

- Option 1: 4 packs of 90 tablets (100 mg).
- Option 2: 4 packs of 90 tablets (300 mg).

Prohibited concurrent reimbursement:never allowed with:

- Gliptins (DPP-4 inhibitors)
- GLP-1 analogs

- Other SGLT2 inhibitors

! Additional reimbursement criteria exist for Chronic Kidney Disease (CKD)

Appendix E: reimbursement criteria for dapagliflozin

1. The specialty can be reimbursed when used for the treatment of patients enrolled in a diabetes care pathway ('zorgtraject').
2. The pharmaceutical specialty (canagliflozin) qualifies for reimbursement when administered to beneficiaries who meet all the following criteria:

- Age > 18 years.
- Glomerular filtration rate (GFR) ≥ 30 mL/min/1.73 m².
- Type 2 diabetes with insufficient glycemic control (HbA1c ≥ 7.0% and ≤ 9.0%) despite hygienic-dietary measures.
- Prior treatment for at least 3 months with at least one antidiabetic agent (including metformin).

Additional Requirements: must be used in combination with at least one other antidiabetic, excluding:

- Incretin mimetics (GLP-1 analogs) for the entire treatment duration.
- Other SGLT2 inhibitors
- Gliptins (DPP-4 inhibitors) added during treatment.

Reimbursement Quantity & Authorization:

- Maximum dosage:1 tablet per day (10mg)
- Initial approval (322 days): 1 pack of 28 tablets (100 mg) + 3 packs of 98 tablets (10 mg).
- Based on a completed and signed application form by the treating physician.
- The advising physician issues an authorization certificate

Renewal (max 392 days per extension):

- For beneficiaries with GFR >60 mL/min/1.73 m²requires HbA1c ≤ 7.5% or ≥ 0.5% reduction from baseline for a maximum of 4 packs of 98 tablets (10 mg)
- For Beneficiaries with GFR 30–59 mL/min/1.73 m²: renewal only requires confirmation that the patient maintains a GFR ≥ 30 mL/min/1.73 m².

Prohibited concurrent reimbursement:never allowed with:

- Gliptins (DPP-4 inhibitors)
- GLP-1 analogs
- Other SGLT2 inhibitors

Appendix F: reimbursement criteria for empagliflozin

1. The specialty can be reimbursed when used for the treatment of patients enrolled in a diabetes care pathway ('zorgtraject').
2. The pharmaceutical specialty (canagliflozin) qualifies for reimbursement when administered to beneficiaries who meet all the following criteria:

- Age > 18 years.
- Glomerular filtration rate (GFR) ≥ 60 mL/min/1.73 m² for a dosage of 25mg/day or GFR ≥ 30 mL/min/1.73 m² for a dosage of 10mg/day
- Type 2 diabetes with insufficient glycemic control (HbA1c ≥ 7.0% and ≤ 9.0%) despite hygienic-dietary measures.
- Prior treatment for at least 3 months with at least one antidiabetic agent (including metformin).

Additional Requirements: must be used in combination with at least one other antidiabetic, excluding:

- Incretin mimetics (GLP-1 analogs) for the entire treatment duration.
- Other SGLT2 inhibitors
- Gliptins (DPP-4 inhibitors) added during treatment.

Reimbursement Quantity & Authorization:

- Maximum dosage:1 tablet per day
- Initial approval (330 days): 1 pack of 30 tablets + 3 packs of 100 tablets (10 mg) OR 1 pack of 30 tablets + 3 packs of 100 tablets (25 mg)
- Based on a completed and signed application form by the treating physician.
- The advising physician issues an authorization certificate

Renewal (max 400 days per extension):

- For beneficiaries with a glomerular filtration rate (GFR) ≥ 60 mL/min/1.73 m², the treating physician must confirm:
    - An HbA1c value ≤ 7.5% or a reduction in HbA1c ≥ 0.5% compared to baseline at treatment initiation for the first renewal of this specialty at a dosage of 10 mg/day or 25 mg/day

OR

- Adequate glycemic control for subsequent renewals of this specialty at a dosage of 10 mg/day or 25 mg/day.

- For beneficiaries with a GFR ≥ 30 mL/min/1.73 m² and < 60 mL/min/1.73 m², the treating physician only needs to confirm that the beneficiary maintains a GFR ≥ 30 mL/min/1.73 m² and < 60 mL/min/1.73 m² for renewals of this specialty at 10 mg/day.

Prohibited concurrent reimbursement:never allowed with:

- Gliptins (DPP-4 inhibitors)
- GLP-1 analogs
- Other SGLT2 inhibitors

Appendix G: Interview questions

1. How familiar are you with the current EASD guidelines for diabetes management and ESC/ESH guidelines for hypertension?

a. (Do you refer to them regularly in practice?)

b. (Do you use any other guidelines for these themes?)

2. How do you stay updated with changes in these or other guidelines?
3. What challenges do you face in implementing these guidelines in your clinical practice?
4. How do you screen patients for diabetes, and what criteria do you use?
5. Do you offer non-pharmacological interventions in the management of (pre-)diabetes?
6. What first-line pharmacological treatments do you recommend for Type 2 Diabetes, and how do you decide?
7. How do you approach individualized HbA1c targets for diabetic patients?
8. How often do you assess cardiovascular and renal risks in diabetic patients? How do you do this?
9. How often and how do you screen for diabetes complications?
10. How do you screen for hypertension? What criteria define a diagnosis of hypertension? Do you routinely use at-home BP measurements?
11. How do you manage white coat hypertension and masked hypertension?
12. What non-pharmacological advice do you provide patients with hypertension?
13. What first-line antihypertensive medications do you prescribe, and why?
14. How do you manage resistant hypertension?
15. Do you routinely screen for secondary hypertension? If yes, in which patients?
16. Do you routinely screen for hypertension complications? And how?

Appendix H: Transcript Interview 1

Interviewer: Dit onderzoek focust op het navolgen van Europese richtlijnen (EASD voor diabetes, ESC/ESH voor hypertensie). Kent u deze richtlijnen en gebruikt u ze actief?

Arts: Ik ken ze, maar niet uit het hoofd. Ik raadpleeg ze wel, maar mijn basisbronnen zijn diverser. Belgische richtlijnen gebruik ik niet.

Interviewer: Hoe blijft u op de hoogte van nieuwe ontwikkelingen?

Arts: Via literatuur (o.a. vakbladen) en praktijkervaring. Updates volg ik, maar niet systematisch.

Interviewer: Zijn er uitdagingen bij het toepassen van richtlijnen?

Arts: Vooral bij hypertensie: één meting in de praktijk is onvoldoende. Zelfmetingen thuis zijn essentieel, maar organisatorisch lastig (terugkommomenten, betrouwbaarheid patiëntrapporten).

Interviewer: Hoe screent u op diabetes?

Arts: Standaard jaarlijks bloedonderzoek (nuchtere glucose) bij 50+'ers en hoogrisicogroepen (obesitas, familiaal beloop). Diagnose stel ik bij twee keer nuchtere glucose >126 mg/dL. Ik doe geen routinematige OGTT want dat is te tijdsintensief, behalve bij zwangerschap.

Interviewer: Hoe gaat u om met prediabetes (glucose 100–125 mg/dL)?

Arts: Jaarlijkse glycemiecontrole + leefstijladvies: matig intensief bewegen (3x/week 30 min) + rookstop + vroegtijdige follow-up bij klachten.

Interviewer: Wat is uw behandelalgoritme?

Arts:

1. Eerste stap: Metformine (opbouw: 500 mg 1x/dag → 2x/dag). Contra-indicaties: ernstige lever-/nierinsufficiëntie.

2. Tweede stap: SGLT2-remmers (bij obesitas/cardiovasculaire comorbiditeit).

3. Target: HbA1c <7%, versoepeld bij ouderen/langdurige diabetes.

Interviewer: Hoe screen jij naar complicaties bij diagnose diabetes?

Arts:Ik doe direct een verwijzing oogarts (fundoscopie), urineonderzoek (microalbuminurie), lipidenspectrum en voor cardiovasculair risico een basisassessment (geen standaard ECG tenzij symptomen).

Interviewer: Hoe volg jij diabeten op?

Arts: ik doe een driemaandelijks HbA1c en jaarlijks voetonderzoek (filamenttest, maar vaak verwaarloosd wegens tijdgebrek). Ik vind dat er een gebrek is aan digitale reminders voor gestandaardiseerde screening wordt als knelpunt genoemd.

Interviewer: Hoe stelt u de diagnose hypertensie?

Arts: ik doe een praktijkmeting en als die ≥140/90 mmHg is, vul ik die aan met thuismetingen (2 weken). De diagnose stel ik dan bij gemiddelde thuiswaarde ≥135/85 mmHg.

Interviewer: Welk leefstijladvies gebruik jij bij hypertensie?

Arts; Gelijk aan diabetes (beweging, gewichtsverlies), met nadruk op:

- Zout- en cafeïnebeperking (beperkt effect, ~10 mmHg daling).

- Slaaphygiëne (OSA uitsluiten bij vermoeden).

Interviewer: Hoe behandelt u hypertensie? Welke antihypertensiva schrijft u doorgaans voor?

Arts: Vroeger was de eerste stap een thiazide, maar toen ik student was, waren er nauwelijks nog betaalbare thiazides beschikbaar. Er was toen net een nieuw middel, maar dat was ook erg duur. Vrij snel daarna kwam het besef: ze zijn allemaal ongeveer even effectief. Dus begon ik te kiezen op basis van indicaties en contra-indicaties. Op een bepaald moment hoorde ik dat het standaard wel oké was om te starten met een ACE-remmer of een ARB. Maar ARB's zijn pas recent beter betaalbaar geworden, met die één-prijsregeling. Dus vroeger startte ik meestal met een ACE-remmer. Dat was mijn eerste stap. Tenzij ze ook ibuprofen gebruikten of een hartprobleem hadden – dan moest je toch oppassen.

Interviewer: En als de bloeddruk dan niet goed onder controle komt met die RAAS-blokkers?

Huisarts: Dan hangt het af van andere factoren: hoe zit het met de polsslag? Hebben ze een hartziekte? Hebben ze astma? Je kijkt altijd naar het volledige plaatje voor je verdergaat.

Interviewer: Werkt u soms met drie middelen?

Huisarts: Ja, dat gebeurt. Afhankelijk van de situatie voeg ik nog andere middelen toe.

Interviewer: En wanneer spreekt u van resistente hypertensie, en hoe pakt u dat aan?

Huisarts: Als ik een eerste middel start, vraag ik hen om na twee weken hun bloeddruk een week lang thuis op te volgen. Daarna zie ik hen terug, meestal na drie tot vier weken.

Als de bloeddruk dan nog niet gedaald is, dan vind ik dat vreemd. Zelfs met één product zou je toch iets van effect moeten zien. Dan denk ik aan onderliggende oorzaken zoals nierproblemen of arteriële schade.

Interviewer: En wat doet u dan? Stuurt u hen door?

Huisarts: Ja, dan stuur ik hen voor een echo, en afhankelijk van wat ik vind, eventueel verder.

Interviewer: En wanneer denkt u aan secundaire hypertensie?

Huisarts: Dat is eigenlijk hetzelfde verhaal. Maar zeker bij jonge mensen, bijvoorbeeld iemand van dertig met hypertensie, dan moet je wel alert zijn.

Als iemand van zestien bij mij komt met duidelijk verhoogde bloeddruk op meerdere momenten, dan begin ik meteen na te denken: is er een familiale belasting? Dan kijk ik naar de familiegeschiedenis en verwijs ik sowieso door naar de cardioloog.

Interviewer: Hoe screent u op complicaties van hypertensie? Hoe vaak doet u dat en wat controleert u?

Huisarts: Minstens één keer per jaar. Dan neem ik bloed en urine. Ik kijk naar de nierfunctie en ook naar risicofactoren zoals cholesterol en bloedsuikers.

Appendix I: Transcript Interview 2

Interviewer: Mijn onderzoek gaat over de richtlijnen van de European Association of Diabetes Studies (EASD) en de European Society of Cardiology (ESC) voor diabetes type 2 en hypertensie. Hoe bekend bent u met deze richtlijnen?

Arts: Ik heb ze sinds mijn studies niet volledig doorgenomen. Mijn laatste bijscholing over hypertensie was via de Belgische Hypertensie Vereniging of de Belgische Cardiologische Vereniging, ongeveer vier jaar geleden. Voor diabetes gebruik ik vooral Belgische richtlijnen, zoals die van Domus Medica, en soms de NHG-standaard uit Nederland.

Interviewer: Hoe blijft u op de hoogte van updates?

Arts: Via bijscholingen, zowel fysiek als online, via onze huisartsenwerkgroep en webinars. Ook krijg ik updates via Medisch Net of andere medische platforms. Soms lees ik artikelen in vakbladen, zoals het Huisartsennieuws van Domus Medica.

Interviewer: Waarom baseert u zich op Belgische richtlijnen in plaats van Europese?

Arts: Omdat de Domus Medica-richtlijnen lokaal toepasbaar zijn, hoewel ze soms verouderd zijn. De NHG-richtlijnen zijn recenter en baseren zich vaak op Europese richtlijnen, maar er zijn kleine verschillen tussen landen.

Interviewer: Hoe screen u op diabetes type 2?

Arts: Ik gebruik zelden de FINDRISC-score. Ik vraag familiaire voorgeschiedenis uit, meet gewicht, en let op zwangerschapsdiabetes bij vrouwen. Bij cardiovasculaire risico's zoals hypertensie of hoog cholesterol vraag ik standaard een nuchtere glucose aan. Ik doe dit meestal via een bloedonderzoek. Een groot deel van mijn patiëntenpopulatie vraagt zelf om bloedonderzoek, voornamelijk voor cholesterol, en dan vraag ik daar standaard een glucose bij.

Interviewer: Wanneer stelt u de diagnose diabetes?

Arts: Officieel bij twee metingen >125 mg/dL met minstens een dag ertussen. Soms zie ik patiënten met normale nuchtere glucose maar hoge HbA1c-waarden. Die behandel ik ook als diabetes, hoewel dit niet helemaal volgens de richtlijn is.

Interviewer: Gebruikt u orale glucosetolerantietests (OGTT)?

Arts: Nee, dat doe ik niet, behalve bij zwangeren. In de richtlijn staat dat een OGTT nuttig is bij hoogrisicopatiënten met normale nuchtere glucose en HbA1c, maar in de praktijk gebruik ik hem niet.

Interviewer: Hoe behandelt u prediabetes?

Arts: Leefstijladvies is de basis. Soms start ik metformine in lage dosis, vooral bij hoog risico, maar dat is uitzonderlijk.

Interviewer: Hoe start u met medicatie bij diabetes?

Arts: Altijd met metformine. Alleen bij onvoldoende effect schaal ik op, bijvoorbeeld met een SGLT2-remmer of GLP-1-agonist, maar vaak houdt terugbetaling me tegen. Bij patiënten met cardiovasculair risico zou ik liever direct met deze middelen starten vanwege hun beschermende effect.

Interviewer: Hoe bepaalt u de streefwaarden voor HbA1c?

Arts: Bij jonge patiënten streef ik naar <6%, bij ouderen <7% of zelfs <8% om hypo's te voorkomen. Het hangt af van leeftijd en comorbiditeiten.

Interviewer: Onderzoekt u complicaties bij diabetes?

Arts: Ja, jaarlijks urineonderzoek voor albuminurie en controle van nierfunctie. Voet- en oogcontroles doe ik volgens richtlijnen, maar bij stabiele patiënten vraag ik me af of dit elk jaar nodig is.

Interviewer: Hoe screen u op hypertensie?

Arts: Ik meet bloeddruk bij risicopatiënten (familiaire belasting, overgewicht) en bij algemene check-ups. Thuismetingen gebruik ik bij twijfel, maar een 24-uursmeting blijft de gouden standaard.

Interviewer: Hoe start u met medicatie bij hypertensie?

Arts: Meestal een combinatie van een ACE-remmer en calciumantagonist. Bij ouderen of nierfalen start ik voorzichtiger. Bètablokkers gebruik ik alleen bij cardiale indicaties.

Interviewer: Wanneer verwijst u door bij resistente hypertensie?

Arts: Als bloeddruk ondanks drie middelen niet daalt, verwijs ik naar de cardioloog. Bij jonge patiënten met onverklaarde hypertensie denk ik aan secundaire oorzaken en verwijs ik eerder.

Interviewer: Onderzoekt u complicaties bij hypertensie?

Arts: Ja, ik luister naar de carotiden en vraag soms een EKG aan. Een oogonderzoek doe ik alleen bij verdenking van retinopathie.

Interviewer: Bedankt voor uw tijd en inzichten!

Arts: Graag gedaan.

Appendix J: Transcript Interview 3

Interviewer: Kent u de Europese richtlijnen voor hypertensie (ESC/ESH) en diabetes type 2 (EASD/ADA)? En gebruikt u ze in uw praktijk?

Huisarts: Ja, ik ken ze wel. Al ben ik in de praktijk soms nog gebaseerd op de oudere Amerikaanse richtlijnen die vroeger veel gebruikt werden. Ik blijf up-to-date via bijscholingen, vooral die van de Universiteit Antwerpen. Soms zijn die commercieel gesponsord, maar vaak ook niet. Mails van het "Huisartsennetwerk" volg ik ook. Artikels lees ik minder actief.

Interviewer: Zou het handiger zijn als richtlijnen automatisch naar u komen?

Huisarts: Ja, zeker. Het is moeilijk om zelf actief te gaan zoeken wat er juist veranderd is. Als die updates automatisch binnenkomen, zou dat veel praktischer zijn.

Interviewer: Wat zijn volgens u de grootste uitdagingen bij het toepassen van richtlijnen?

Huisarts: De grootste uitdaging is het doorbreken van gewoontes. Je werkt vaak op automatische piloot. Als een richtlijn versoepelt of wijzigt, moet je je denkpatroon aanpassen, en dat is niet vanzelfsprekend.

Interviewer: Hoe screent u op diabetes?

Huisarts: Iedereen boven de 50 jaar laat ik jaarlijks standaard een bloedname doen, inclusief nuchtere glycemie. Als die boven de 100 mg/dL is, doe ik meestal al meteen een HbA1c. Strikt genomen zegt de richtlijn dat dat pas nodig is vanaf twee nuchtere waarden ≥126 mg/dL.

Interviewer: Welke HbA1c-waarde beschouwt u als diabetes?

Huisarts: Vanaf 6% begin ik alert te worden. Richtlijnen zeggen 6,5%, maar ik wacht daar niet op. Ik ben daar vrij streng in, omdat ik microvasculaire schade wil voorkomen.

Interviewer: Gebruikt u een OGTT?

Huisarts: Ja, in twijfelgevallen, zeker bij jongere mensen of als de suikers afwijken terwijl het profiel dat niet doet vermoeden. Bijvoorbeeld een sportieve vijftiger met wisselende waarden.

Interviewer: Wat doet u na het stellen van de diagnose?

Huisarts: Eerst levensstijladvies: voeding, beweging, gewichtsverlies. Ik verwijs meestal naar een diabeteseducator of diëtist. Medicatie is pas stap twee. Na drie maanden controleer ik opnieuw.

Interviewer: En als u medicatie opstart?

Huisarts: Dan begin ik altijd met metformine. Ik bouw het traag op tot drie keer 500 mg per dag, afhankelijk van de patiënt. Dat combineer ik met opvolging na drie maanden.

Interviewer: Gebruikt u sjablonen of een gestructureerde opvolging?

Huisarts: Vroeger wel, met sjablonen in oudere software. Nu minder. Ik probeer wel afspraken op voorhand te plannen, bijvoorbeeld bloedname en consultatie drie maanden later. Alleen bij stabiele patiënten laat ik zes maanden tussen.

Interviewer: Hoe screent u voor hypertensie?

Huisarts: Vanaf 40 jaar meet ik bij bijna iedereen de bloeddruk. Onder de 40 enkel klachtgericht: hoofdpijn, moeheid, hartkloppingen... Of bij een risicoprofiel, zoals rokers. Ik volg het meer op basis van context dan leeftijd alleen.

Interviewer: Gebruikt u ook thuismetingen?

Huisarts: Ja. Veel mensen hebben zelf een bloeddrukmeter. Zeker bij jonge mensen met verhoogde waarden, geef ik graag een meter mee om thuis op te volgen.

Interviewer: Wat is uw drempel om behandeling te starten?

Huisarts: Dat hangt af van het risico. Bij een patiënt met cardiovasculaire voorgeschiedenis streef ik naar <130/80 mmHg. Bij jonge mensen zonder risicoprofiel wacht ik tot waarden rond 145–150 mmHg. Dan werk ik meestal met thuismetingen.

Interviewer: Ouderen?

Huisarts: Bij 80-plussers mag het wat hoger. Maar ik let wel op plotse schommelingen, zeker bij oudere patiënten die anders stabiele waarden hebben.

Interviewer: Welke bloeddrukverlagers schrijft u voor?

Huisarts: Vroeger begonnen we standaard met een thiazide, maar die waren toen niet meer beschikbaar of onbetaalbaar. Daarna zijn we meer met ACE-remmers gestart. Nu kies ik afhankelijk van de patiënt tussen ACE of ARB. Bijwerkingen of comorbiditeiten bepalen de keuze. Als dat niet werkt, kijk ik naar polsslag, astma, hartproblemen…

Interviewer: En als dat onvoldoende werkt?

Huisarts: Dan bouw ik verder uit naar combinaties, soms tot drie middelen. Ik controleer na enkele weken of er verbetering is, anders denk ik aan onderliggende oorzaken.

Interviewer: Wanneer denkt u aan secundaire hypertensie?

Huisarts: Bij jonge patiënten of als iemand plots extreem hoge bloeddruk heeft, bijvoorbeeld 200/110 mmHg. Dan verwijs ik meestal door naar de cardioloog voor verder onderzoek. Zelf test ik niet actief via bloed of urine.

Interviewer: Worden er vaak secundaire oorzaken gevonden?

Huisarts: Nee, ik heb het al regelmatig laten uitzoeken, maar nog nooit dat er effectief iets aan de hand bleek. Nierfunctie kijk ik wel standaard na.

Interviewer: Hoe screent u op complicaties?

Huisarts: Minstens jaarlijks. Bloed- en urinetests, nierfunctie, cholesterol en bloedsuiker. Eerder breed, ook om risico in te schatten.

Appendix K: Transcript Interview 4

Interviewer: Mijn onderzoek focust op de EASD- en ESC-richtlijnen (Europese richtlijnen voor diabetes en hypertensie). Kent u deze richtlijnen? Of gebruikt u andere?

Arts: Eerlijk gezegd ken ik die richtlijnen niet goed. Ik baseer me vooral op ervaring en pas aan via artikelen of updates. Ik volg niet strikt specifieke richtlijnen.

Interviewer: Hoe blijft u dan op de hoogte van nieuwe ontwikkelingen?

Arts: Ik lees online, bijvoorbeeld in Artsenkrant of via Tempo Medical. Soms krijg ik ook informatie van farmaceutische vertegenwoordigers, maar die is niet altijd objectief.

Interviewer: Hoe screent u op diabetes in uw patiëntenpopulatie?

Arts: Bij routinebloedonderzoek (voor patiënten 50+) meet ik standaard glucose. Bij afwijkende waarden volgt een HbA1c-bepaling.

Interviewer: Doet u ook orale glucosetolerantietests (OGTT)?

Arts: Nee, alleen bij zwangerschapsdiabetes.

Interviewer: Maakt u onderscheid tussen prediabetes en diabetes?

Arts: Ja. Bij prediabetes geef ik leefstijladvies en volg ik patiënten nauwer op (bijv. na 6 maanden opnieuw HbA1c).

Interviewer: Welk leefstijladvies geeft u?

Arts: Verwijzing naar de verpleegkundige voor voeding, gewichtsverlies en beweging. Ik check ook hypertensie en cholesterol.

Interviewer: Start u direct met medicatie?

Arts: Ja, meestal met metformine. Bij overgewicht overweeg ik SGLT2-remmers (bijv. dapagliflozine) vanwege gewichtsverlies en cardiovasculaire voordelen.

Interviewer: Hoe stelt u behandeldoelen (targets)?

Arts: Ik hanteer een vuistregel: leeftijd gedeeld door 10. Bij een 60-jarige streef ik naar HbA1c ≤6,5%, bij 90-jarigen accepteer ik ≤8%.

Interviewer: Gebruikt u continue glucosemeters?

Arts: Nog niet, maar we overwegen dit voor selectieve patiënten.

Interviewer: Hoe screent u op complicaties?

Arts: Jaarlijks voetonderzoek (filamenttest), nierfunctie, microalbuminurie, oogartsverwijzing. Driemaandelijks: HbA1c en bloeddruk. Cardiovasculair risico: afhankelijk van profiel (soms carotis-echo).

Interviewer: Hoe screent u op hypertensie?

Arts: Bloeddrukmetingen in de praktijk en thuis (via zelfmeting). Bij herhaalde waarden >140/90 start ik behandeling.

Interviewer: Wat is uw eerste keus-medicatie?

Arts: Meestal een combinatie van lage doseringen (bijv. ACE-remmer + diureticum). Bij stressgerelateerde hypertensie soms een bètablokker.

Interviewer: Hoe gaat u om met wittejashypertensie?

Arts: Ik vergelijk praktijkmetingen met thuiswaarden. Bij discrepantie adviseer ik zelfmeting of 24-uursmeting.

Interviewer: Wanneer spreekt u van resistente hypertensie?

Arts: Bij bloeddruk >160/100 ondanks drie middelen. Dan verwijs ik naar de cardioloog voor uitsluiten secundaire oorzaken (zelden gevonden).

Interviewer: Hoe screent u op orgaanschade?

Arts: Jaarlijks: nierfunctie, microalbuminurie, lipidenspectrum. Hoogrisicopatiënten: carotis-echo (bij rokers/sterke familie-anamnese).

Interviewer: Bedankt! Ik stuur nog een samenvatting van bevindingen voor uw praktijk.

Arts: Graag gedaan.

Appendix L: Transcript Interview 5

Interviewer; Mijn onderzoek gaat over de richtlijnen van de European Association for the Study of Diabetes (EASD) en de European Society of Cardiology (ESC) voor diabetes type 2 en hypertensie. Hoe bekend bent u met deze richtlijnen?

Arts: Ik moet zeggen dat ik die richtlijnen niet grondig ken. Ik baseer me vooral op ervaring en pas mijn aanpak aan op basis van nieuwe artikels of updates. Ik volg ze niet strikt.

Interviewer: Hoe blijft u op de hoogte van nieuwe ontwikkelingen?

Arts: Ik lees online artikels, bijvoorbeeld in *De Artsenkrant* of via medische platforms zoals Tempo Medical. Soms krijg ik ook informatie van farmaceutische vertegenwoordigers, maar die probeer ik kritisch te bekijken.

Interviewer: Hoe screent u op diabetes type 2 in uw praktijk?

Arts: Bij een routinebloedonderzoek (vaak om de twee jaar voor 50-plussers) meet ik standaard glucose. Als die afwijkend is, vraag ik een HbA1c aan. Bij patiënten met risicofactoren (familiale belasting, overgewicht) screen ik actiever.

Interviewer: Gebruikt u orale glucosetolerantietests (OGTT)?

Arts: Nee, alleen bij zwangerschapsdiabetes. Bij vermoeden van prediabetes of diabetes vertrouw ik op nuchtere glucose en HbA1c.

Interviewer: Doet u iets met prediabetes?

Arts Ja, ik geef leefstijladvies (voeding, beweging) en volg hen nauwer op, bijvoorbeeld na zes maanden opnieuw bloedcontrole. Soms start ik metformine in lage dosis bij hoog risico.

Interviewer: Welke medicatie start u bij diabetes?

Arts: Meestal metformine. Bij onvoldoende effect of overgewicht schakel ik over op SGLT2-remmers (zoals dapagliflozine), vooral vanwege gewichtsverlies en cardiovasculaire bescherming.

Interviewer: Hoe bepaalt u streefwaarden voor HbA1c?

Arts: Ik hanteer een vuistregel: leeftijd gedeeld door 10. Bij jongere patiënten streef ik naar <6-6,5%, bij ouderen (<80 jaar) naar <7-8%.

Interviewer: Screenen op complicaties?

Arts: Jaarlijks: nierfunctie, microalbuminurie, voetonderzoek (filamenttest), en bloeddruk. Bij nieuwe patiënten met hoge HbA1c controleer ik sneller op complicaties. Oogartsverwijzingen gebeuren via het zorgtraject.

Interviewer: Hoe screent u op hypertensie?

Arts: Bloeddrukmeting bij risicopatiënten (familieanamnese, overgewicht). Bij verhoogde waarden geef ik een thuismeter mee voor zelfmeting. Een 24-uursmeting is ideaal, maar praktisch lastig.

Interviewer: Wanneer start u medicatie bij hypertensie?

Arts: Bij herhaalde metingen >140/90 mmHg. Ik begin vaak met een combinatie (ACE-remmer + calciumantagonist). Bij stressgerelateerde hypertensie overweeg ik een lage dosis bètablokker.

Interviewer: Hoe gaat u om met resistente hypertensie?

Arts: Als drie medicijnen onvoldoende werken (bloeddruk >160 mmHg), verwijs ik naar de cardioloog voor verder onderzoek. Secundaire oorzaken (zoals nierarteriestenose) zijn zeldzaam maar moeten worden uitgesloten.

Interviewer: Screenen op hypertensiecomplicaties?

Arts: Jaarlijks bloedonderzoek (nierfunctie, cholesterol) en urineonderzoek (microalbuminurie). Bij hoog cardiovasculair risico overweeg ik een carotidisecho, maar dit is geen standaard.

Interviewer: Bedankt voor uw tijd!

Arts: Graag gedaan.